# APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

FEBRUARY, 1951

- HYDRAULIC CIRCUITS
- HYDRAULIC CONTROLS
- AIR CIRCUITS
- AIR CONTROLS
- ELECTRICAL AND ELECTRONIC CONTROLS

## IN THIS ISSUE

COMBINE THREE CONTROLS

DESIGN OF PISTON TYPE ACCUMULATOR

OUTPUT TRIPLED WITH AIR DRIVEN NAILS

HYDRAULICS IN BULLDOZERS

THE EVOLUTION OF A CIRCUIT

DEVELOPMENT OF THE UNLOADING GEAR PUMP

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# applied HYDRAULICS

February, 1951 Vol. 4, No. 2



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## CONTENTS


Combine Three Controls ---- 17
By A. H. Schutt
Hydraulic, mechanical and electrical control are combined in a special purpose, high production drilling machine.

Hydraulics in Bulldozers ---- 20
By Morton M. Coker
Space, float control and component selection are several of the emphasized design problems.

BASIC HYDRAULICS SECTION

Hydraulic Pumps ---- 22
Chapter VIII, Part 2

The Evolution of a Circuit ---- 24
By Howard Field, Jr.
A hydraulic system is applied to a lathe for longitudinal feed. The step-by-step development illustrates "Design Thinking".

Design of Piston Type Accumulator ---- 26
By M. J. Phillips
Positive pressurized "O" seals prevent leakage and offer minimum frictional resistance to the moving piston.

Output Tripled with Air Driven Nails ---- 28
By Lee H. Cruse
Careful selection of air components has been combined with mechanical ingenuity to provide feeding and setting of nails.

Snow . . . thousands of tons moved with oil ---- 30

Fluid Power Gives Muscles to Material Handling Equipment ---- 32
Seven application pictures show the versatility of oil operated positioners.

Reduce Operating Costs with Purifiers ---- 34
Two companies tell how they reclaim and condition synthetic fluids.

AVIATION HYDRAULICS SECTION

Development of the Unloading Gear Pump ---- 36
By Ernest H. Schanzlin
A variable volume gear pump is designed to operate in aircraft.


## DEPARTMENTS


Letters to the Editor ---- 8
Here's How ---- 19
New Components ---- 40
Useful Catalogs and Bulletins ---- 46
Literature in This Month's Ads ---- 52
Market Place ---- 52
Post Scripts of Industry ---- 62



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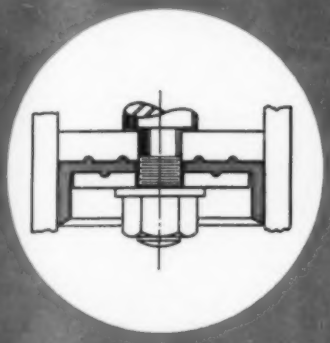
**FRONT COVER: Rapid accessibility to the jet power plant of Northrop's Scorpion F-89 is made possible by a "swing out" type oil actuated mechanism. Photo by Western Round-Up**

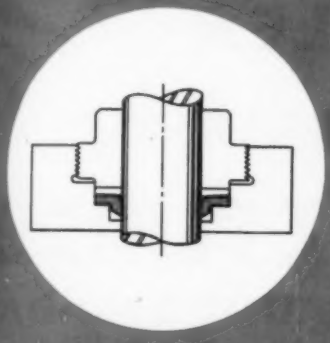
# CUSTOM MADE

## TROSTEL HYDRAULIC AND PNEUMATIC PACKINGS



### CUP PACKINGS

Cup Packings are the most commonly used means of sealing fluid in a hydraulic activated piston. Major applications are in presses, pumps, jacks and feed mechanisms for all types of industrial equipment. Trostel cup packings, leather (as illustrated) or rubber, are properly designed to give you top performance.



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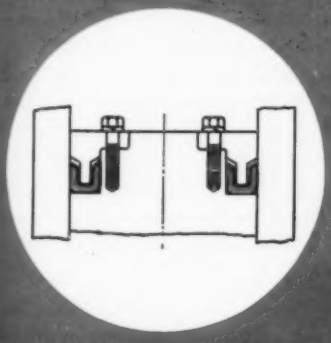

### U PACKINGS

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Solid steel heads, caps and mountings which eliminate costly, dangerous breakage even under the severest operating conditions represent an "extra-quality" standard Miller cylinder feature which actually exceeds the high quality set by the J. I. C. Standards.

The Miller "Patented" Hydraulic Piston Rod Seal which has no manual adjustment and is automatically self-adjusting and wear-compensating to give life-long leakproof service without ever requiring any manual adjustment whatsoever . . . far surpasses the requirement of J. I. C. Standard H6.2.5 which specifies "Stuffing boxes for automatic packing shall be so designed as to prevent adjustment beyond the functional limits of the packing"

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**NO REPAIRS**

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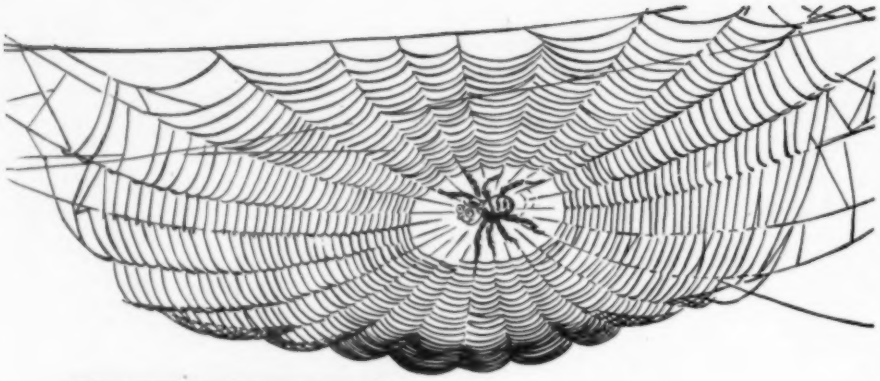


**UNSOLVED:**

## How can a Spider spin this web in half an hour?

He's a traveling factory! Suppose we could duplicate this spider *man-size:* we'd require about 5 miles of cable for this web. What we'd make it of and how we'd erect it in 30 minutes is just part of the mystery!

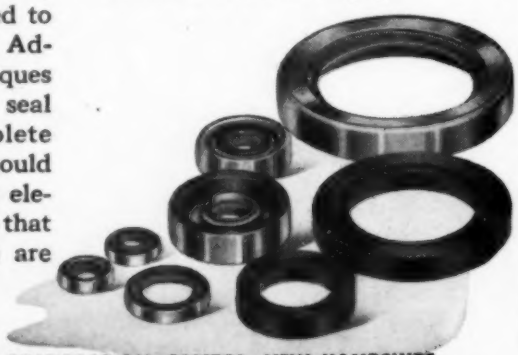
**SOLVED:**

## How to make efficient Oil Seals with fewer metal parts

Today as never before, oil seals are being designed for specific jobs, and the art of fluid sealing has become a science.

Improved materials and techniques share this responsibility. Synthetic rubber and plastics are being adapted to more efficient sealing. Advanced moulding techniques have kept pace with oil seal design: today the complete seal emerges from the mould with metal and sealing element perfectly bonded, so that multiple metal housings are not required.

G&K-INTERNATIONAL has pioneered many of these advances to meet the needs of speed, material, lubricants, temperature, pressure, *space and assembly*. Making Oil Seals to seal your oil is our business. We can help you.



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# LETTERS to the Editor

*We had two more letters from our readers giving early applications of hydraulics to machine tools. Excerpts follow:*

We were particularly interested in a letter appearing in the October issue requesting assistance in identifying the first hydraulic application to machine tools. Our records show that in 1915 we applied a hydraulic variable speed transmission to a lathe spindle in our shop (Waterbury Tool) then located in New Britain, Conn., and our workmen found this arrangement far superior to changing the belt on the stepped-pulleys. This lathe was used for a number of years, until the transmission became so worn that it was scrapped.

Our records also show that we supplied a variable delivery pump, for operating a broach built by the J. N. LaPointe Machine Tool Company, then located at New London, Conn. This broach application was made rather late in 1922, and therefore checks with the recollection of Mr. Lassman to the effect that the first hydraulic application on a broach was made approximately 28 years ago. The extensive use of hydraulic drives in industry today as compared to a few limited applications some thirty-five years ago, is not only remarkable, but gratifying to those who first pioneered this type of drive.

H. G. G.

In connection with a recent inquiry in Letters to the Editor in your October issue, you may be interested in the following information, supplied by R. L. Tweedale of Vickers, Inc.

Conrad M. Conradson patented a hydraulic lathe (1,140,299) filed in 1914.

James Hartness of Jones and Lamson Machine Co. took out several patents on hydraulic turret lathes. The earliest patent (739,866) was filed in 1901. Hartness, prominent at Jones and Lamson, eventually became Governor of Vermont.

An early application other than machine tools was made in 1906 by Harvey Williams and Reynold Janney, who were responsible for installing the first axial plunger variable speed hydraulic transmission on the U.S.S. VIRGINIA.

W. E.

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## the rugged new fluid power pump

YOU'LL END your fluid power problems with HYDRAMITE, the hydraulic pump with high pressure capacity built in. This radically new radial multi-piston, constant displacement, oil-operated pressure generator maintains pressures up to 5000 p.s.i.

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Designed and built by American Engineering Company, makers of the famous Hele-Shaw Pump, many HYDRAMITES are today setting new standards of efficiency on various types of high pressure hydraulically-operated equipment.

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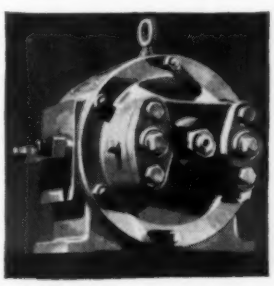

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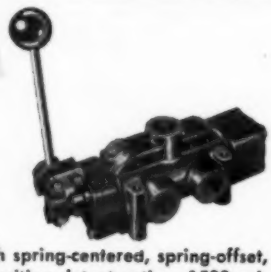
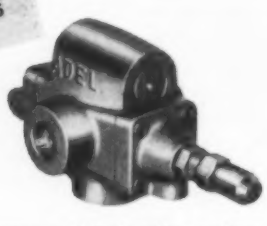


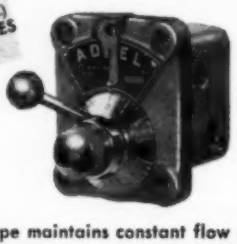
4-way valves with spring-centered, spring-offset, and 1, 2, or 3 position detent action. 1500 psi. Flows to 28 gpm.

BY-PASS VALVES



Relief, Sequence and Unloading valves. Direct or remote operation, 50 to 1500 psi range.

VOLUME (FLOW) CONTROL VALVES

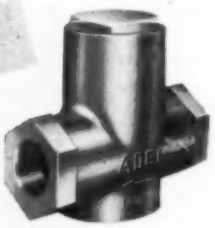


Compensated type maintains constant flow over wide differential pressure range. No drain line required. 1500 psi.

PILOT VALVES

2 or 3 position detent. With or without dog or lever. Can be used as 4-way valve in small circuits. 1000 psi.

CHECK VALVES



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Please advise how we could obtain the paper "Cavitation in Piston and Gear Type Pumps" by R. J. S. Pigott, as reported on page 19 of your September, 1950 issue. Your assistance is appreciated.

R. H. L.

*Mr. R. J. S. Pigott's paper "Cavitation in Piston and Gear Type Pumps" was presented at the National Conference on Industrial Hydraulics in October at Chicago. This paper, with all other papers given at that time, will be published in the next volume of the Conference Proceedings. We understand that the Proceedings will be published during 1951. We suggest, in the interest of speed, that you write Mr. Pigott, director of engineering, Gulf Research and Development Company, Pittsburgh, who may have a copy for examination-loan.*

---

As we are redesigning our line of pneumatic equipment for industrial applications, we would be deeply interested in learning more about the tentative J. I. C. Pneumatic Standards and also the procedure for becoming a member of this conference. We learned of this from a story in your October issue.

A. P. S.

*A resume of the work already accomplished by the J. I. C. Pneumatics Standards group has been sent you in a letter as well as the name of the secretary of the Joint Industry Conference.*

---

In your May 1950 issue I was interested in Part III of the article on Hydraulic Seals by Mr. R. O. Isenbarger. I thought it was very well done and immensely interesting. Since we have six men travelling on the road, I would like to obtain six sets of all three parts of this article. Your magazine proved very interesting to me at the American Locomotive Company in Schenectady the other day.

L. W.

*Mr. Isenbarger's company has ordered a reprinting of his article and we have forwarded your request on to him for attention. We appreciate your interest in our magazine.*

---

We would like to know if reprints of the articles, "How to Choose the Proper Packing" and "Directional Valves", Chapter VII, Part 3, that appeared in the September, 1950 issue of APPPLIED HYDRAULICS, are available.

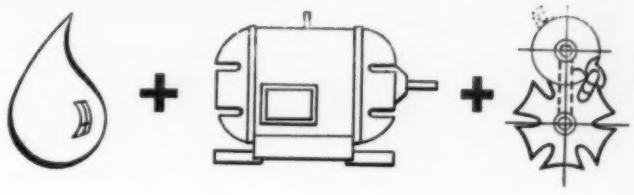
H. L. W.

*Neither of these articles have been reprinted but we have sent you tear sheets of these two articles.*

*(Continued on page 61)*

# COMBINE THREE CONTROLS

By A. H. SCHUTT
Chief Engineer
Zagar Tool Inc.



HERE IS A SPECIAL PURPOSE HIGH PRODUCTION drilling machine which shows how the designers have combined electrical, hydraulic and mechanical control for efficient, low cost operation.

Hydraulic power is used to slowly feed the work into the drills and rapidly return the work.

Electrical energy powers the hydraulic pumps, rotates the drilling head, cycles the index table, and supplies coolant.

Mechanical control for the index table is supplied by using a Geneva motion.

The machine built by Zagar Tool Inc., Cleveland, was specially designed to drill 21 holes, using 7/32, ¼ and ⅜ in. drills, in a 1 11/16 diameter slug of 5/16 in. thick SAE 1045 steel.

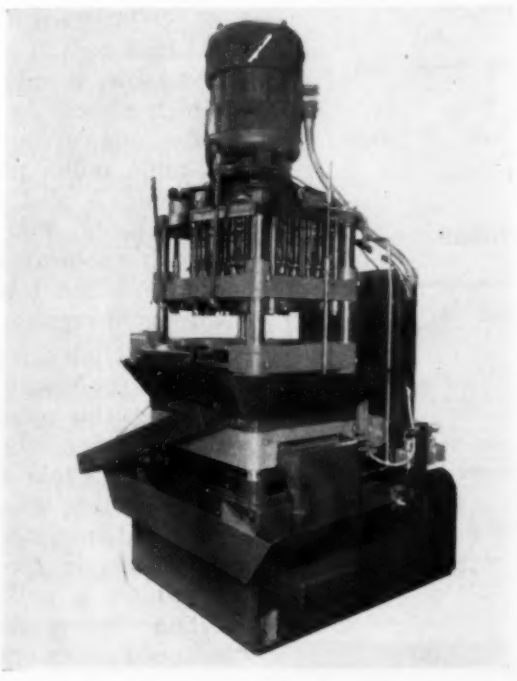
With so many holes clustered on such a small plate, the part has the appearance of a sink strainer. Because of the close hole spacing, one loading and five drilling stations are used on this 84 spindle machine. Each station holds four parts.

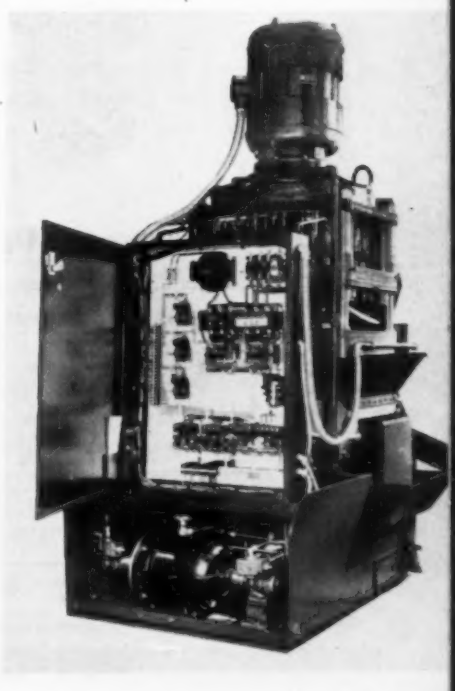
During a dwell the work table indexes. Then the ram moves the work table up into the drills. While the ram is moving four parts are loaded. When all stations are full, four pieces are completed during each cycle of approximately 15 seconds.

### Hydraulic Circuit

The hydraulic system was designed to provide a slow drilling feed rate for the ⅝ in. working stroke and a rapid downward return of the work table. The total available stroke of the ram is 10 in. permitting sufficient travel to make room for setting up the drills. When the drills are set, the ram is positioned by setting the electrical switches, so that the short ⅝ in. work stroke is near the top of the ram travel.

To obtain slow up feed and rapid return, it was decided to use two separate vane pumps, 1 and 2. When solenoid A is energized the 2.5 gpm pump capacity is directed through ports P





The work table on this 84 spindle, six station, drilling machine is moved up into the drills under oil power. A slow drill feed and a rapid return are provided by the two pump system.

In the base of the machine, is the electric motor driving a pump at each end of its shaft. The electrical control panel shows the mounting of the relays which control the sequence of the cycle. Using 3 limit switches and a pressure switch, completely automatic cycling is obtained.

and A to the blank end of the ram cylinder providing slow feed. Return oil from the rod flows back to tank through port B to T. Volume of the high capacity pump is also directed to tank by joining the return flow from the cylinder. For rapid lowering of the work table, flow from both pumps are combined. Solenoid B is energized to move oil from pump 1 to the rod side of the cylinder. This volume combines with flow of pump 2 at junction "Z".

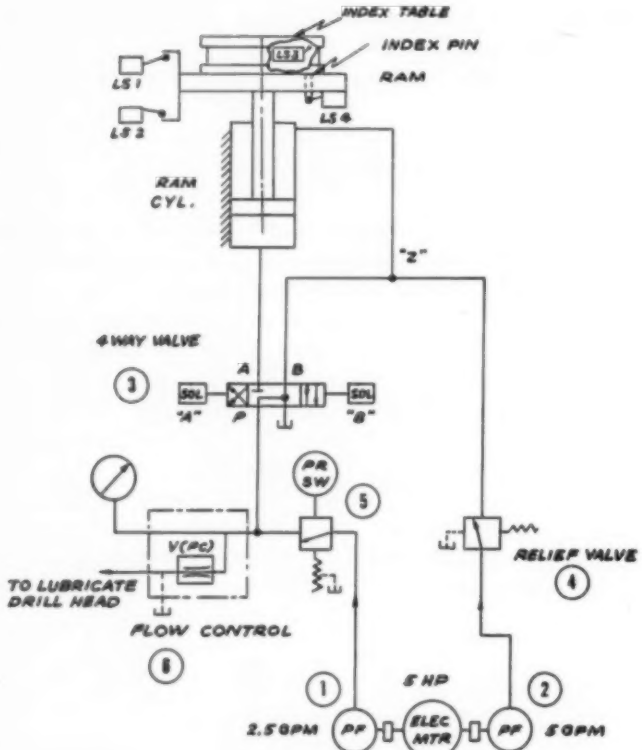
During the dwell in the cycle for indexing, 4-way valve 3 is centered, allowing oil from pumps 1 and 2 to discharge to the tank. Port A in valve 3 is blocked, trapping oil on the lower side of the piston to prevent the ram from dropping.

Flow control for feeding is controlled by valve 6. A portion of the bled off oil volume is directed from the flow control valve to lubricate the drilling head.

An interesting design feature is the introduction of the pressure switch for automatic cycling. The pressure switch is used to deenergize solenoid A and energize solenoid B which starts the downward travel. When the machine was being designed it was first thought that a limit switch could easily perform this function. The ram would raise to the desired height, trip the limit switch, and start downward. A limit switch did not do the job because the drilled holes had to have a 1/32 in. radius at the top edge, making it necessary to use stepped drills. The use of stepped drills adds the requirement of depth control. It was also found that a dwell at the top of the stroke was required to assure a clean radius. Using a limit switch, it was found that some pieces were not radiused because the drills did not bottom and in some pieces the radius was ragged where the parts could not dwell to clean up.

Using a pressure switch the ram dwells momentarily at the top of its stroke until the oil pressure opens the switch to energize solenoid B.

In oil lines carrying only the capacity of a single pump, ½ in. tubing was used. In the branch where the volumes combine, the tubing diameter is ¾ in.




## Sequence of Operation

| | Ram Position | Index | Sol. A | Sol. B |
|---|---|---|---|---|
| Cycle start button | idle at bottom | start | | |
| LS 3 | | stops | | |
| LS 4 | starts up | | ener. | |
| PS | starts down | | deener. | ener. |
| LS 1 | bottom | start | | deener. |
| LS 2 | stop switch for single, maual cycling | | | |

### Electrical Circuit

Four limit switches and a pressure switch control the sequence in the cycle. When the work table is down, LS 1 is closed dropping out relay B and solenoid B and bringing in the indexing relay to rotate the work table.

Limit switch 3, which is located inside the index table, is operated by the Geneva drive crank which closes the switch when the crank starts. After one revolution, LS 3 opens the index table. A table index pin then closes LS 4 to energize solenoid A and start the upward travel of the work table. For the return stroke the pressure switch energizes solenoid B and deenergizes solenoid A. The table descends tripping LS 1 and the cycle repeats.

Limit switch 2 is in the circuit to act as a selector switch for single cycling which can be used for making the machine setup. Limit switch 2 is tripped open when the table is up. This deenergizes the cycle start relay preventing the ram from cycling when LS 1 trips. The cycle is then repeated manually by pressing the start button. As shown in the photo, LS 2 is tripped by the action of a collar on a rod. When automatic cycling for production is required the collar is dropped on its rod so that it does not strike LS 2.

# HERE'S HOW

- PREVENTIVE MAINTENANCE
- SERVICE PROCEDURES
- MODERNIZATION
- SHORT CUTS

## Bumper Absorbs Cylinder Shock

ON AN APPLICATION WHERE AN AIR CYLINDER was used to position a hydraulic directional valve, we experienced severe shock impulses on the valve spool.

We had chosen to move the spool pneumatically because this control gave us very high-speed action and requires little maintenance or repair. Using a standard cylinder, the high-speed shifting resulted in impacts which, beside being uncomfortably noisy, were the cause of vibration at the fittings and would surely have damaged the valve if permitted to continue.

Some means of absorbing the shock had to be devised. The end cap on the air cylinder was removed and a ½ in thick piece of composition rubber-fabric bumper stock was cut to fit in the cap, over the piston rod. The bumper prevents the transmission of shock to the valve by cushioning the blow of the piston.

E.F.H.

## Lubrication of Directional Air Valves

WHEREVER A HIGH CYCLE OF OPERATION IS INvolved it is quite important that frictional forces are smaller than the force available to return the valve. To avoid sticky valves a small amount of lubrication must be provided.

On solenoid valves that operate at 300 cpm, automatic type oilers are provided to assure continuous duty. For operation below 300 cycles, the user has two approaches for maintaining his valves. First, he could set up a rigid maintenance schedule, requiring regular oiling of valves in the system. Such a procedure would be more costly than automatic oilers.

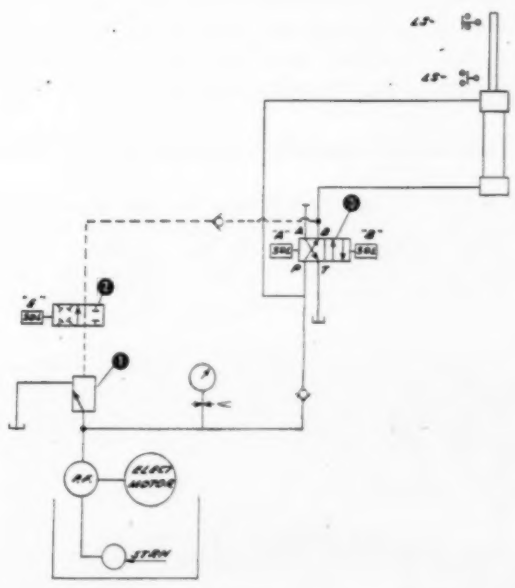
Second, by proper consideration to operating temperatures, a lubricant may be selected which will remain in the valve and not necessitate the installation of an oiler or any special maintenance.

Because of its water resistant characteristic, we have selected a barium grease, for our air valves operating at normal operating temperature of 65 to 150 F. This grease has proved to be effective in providing continuous duty by minimizing the effect of dirt and water which may be in the system.

N. A. PEDERSEN
Salem, Ohio

## Piping Connections for an Unloading Valve

THE CIRCUIT SHOWN HERE IS TYPICAL OF DIFFERential circuits used to power hydraulic cylinders. Engineering this circuit, which includes only necessary components—pump, directional control valve, relief valve and cylinder—is based on the desired output forces. In this particular application, the cylinder was to do its work during only a small part of the working cycle. To save power during the "non-working" time, it was decided to unload the pump capacity back to tank, at near zero pressure.



Unloading can easily be accomplished by venting a commercial relief valve. This is done by opening a vent connection on the relief valve (1) to atmospheric pressure. This unbalances the relief valve and dumps the pump capacity back to tank.

*(Concluded on page 44)*

Submit your design hint or labor saving idea. BEST OF THE MONTH earns $10. Every published item brings you $5.

By **MORTON M. COKER**
Caterpillar Tractor Co.

# HYDRAULICS IN BULLDOZERS

DEVELOPMENT AND MANUFACTURE OF HYDRAULIC power units by the Caterpillar Tractor Co., for use with bulldozers, was started in 1946. The speed and work capacity of cable control units were used as the basis for setting the ultimate goal of the hydraulic units. To fulfill this requirement the horsepower output of the hydraulic unit produced today is as much as three and one-half times those produced about six years ago.

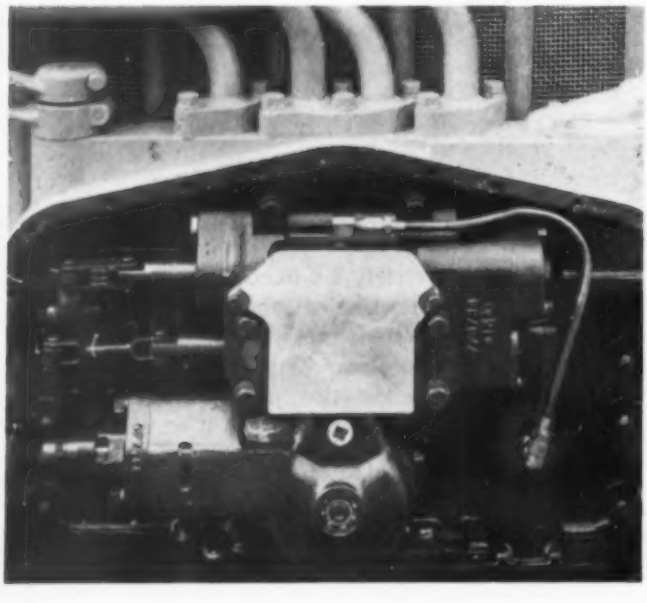
In locating the hydraulic power unit at the front of the Caterpillar tractor and directly connecting it to the engine crankshaft, use of the power unit is available at any time the engine is running, regardless of whether or not the master clutch is engaged. To keep the unit as compact as possible and to eliminate as much of the piping common to hydraulically equipped tractors, the pump, relief valve, and control valve were all placed within the oil reservoir, Figures 1 and 2.

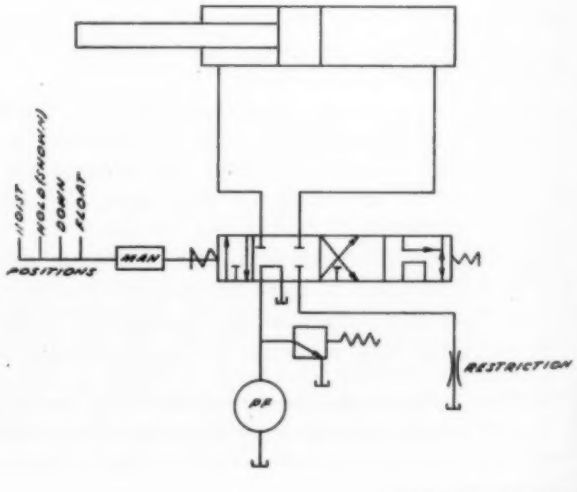
After including these components in the reservoir it was provided with a filler arrangement such that a volume of air is always present above the oil level. In this manner contamination permitted by external breathing is completely eliminated. This arrangement also keeps condensation at a minimum since entrance of moisture laden air is very limited. The volume of air is provided in the reservoir to permit thermal volume changes and to take care of change of reservoir oil level during operation due to hydraulic cylinder rod displacement.

## Small Reservoir Capacity

In order that the unit not become so large that it would unduly affect engine cooling the amount of space it is permitted to occupy is limited and the amount of oil in the reservoir is relatively

**Fig. 1. The hydraulic system on the light dozer unit uses a restricting orifice in the cylinder return line to take the place of a counterbalancing valve. The lighter blade and the smaller amount of oil displaced during operation permit the satisfactory application of the orifice. The hydraulic unit is located at the front of the tractor taking its power from the engine crankshaft.**





*Counterbalancing Loads*
*Dozer Blade Control*
*Location of System*
*Pressure Selection*
*Oil Tight Design*
*Pump Selection*

small. For a system circulating 100 gpm the reservoir contains about 8½ gallons of oil. The volume of air space provided in the reservoir is also limited and this does not permit the use of a circuit which is not kept filled at all times. In other words, the circuit had to be one in which it was impossible for the cylinders to move ahead of the pump output. In considering the circuit to be used it was necessary to consider all possible results of control valve positioning with engine dead as well as with engine running at any and all possible speeds. In the final design of the circuit, counterbalance valves are employed which will prevent any movement of hydraulic cylinder piston unless pressure is applied to the side of the piston opposite the direction of movement. This feature of the circuit also assures the operator of instant response in applying down pressure to the bulldozer blade which is not the case when a gravity drop is ordinarily used.

## Use of Spring Centered Valve

Since it is necessary to carry a bulldozer blade above the ground for considerable periods of time while doing other types of work, the control valve must have a minimum of leakage. Also, the control valve must be a type that blocks both sides of the power cylinder circuit. To meet these requirements and in addition provide an easily operated valve it was deemed best to use a spring centered spool type valve. Due to the blind cross-over condition encountered with each shift of this type valve the use of a conventional relief valve causes an objectionable pump pressure rise with each shift of the valve. This pressure is somewhat above the actual relief valve pressure

*(Continued on page 56)*

1. Counterbalance control valve
2. Float check valve
3. Counterbalance valve
4. Overload type relief valve

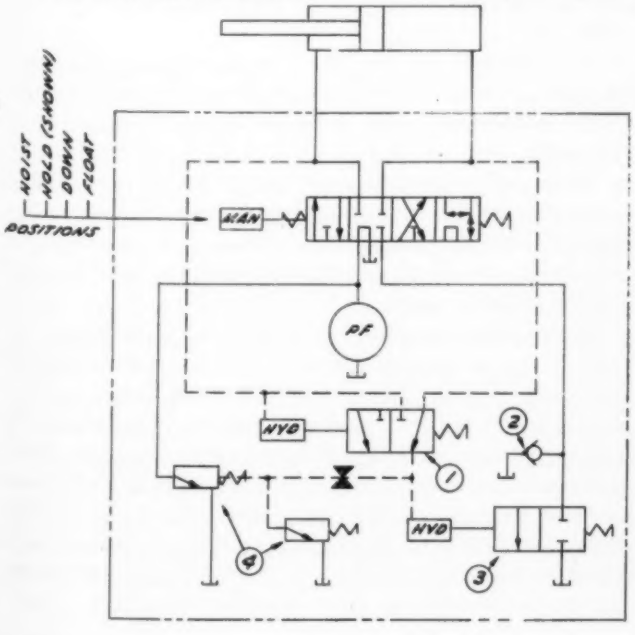
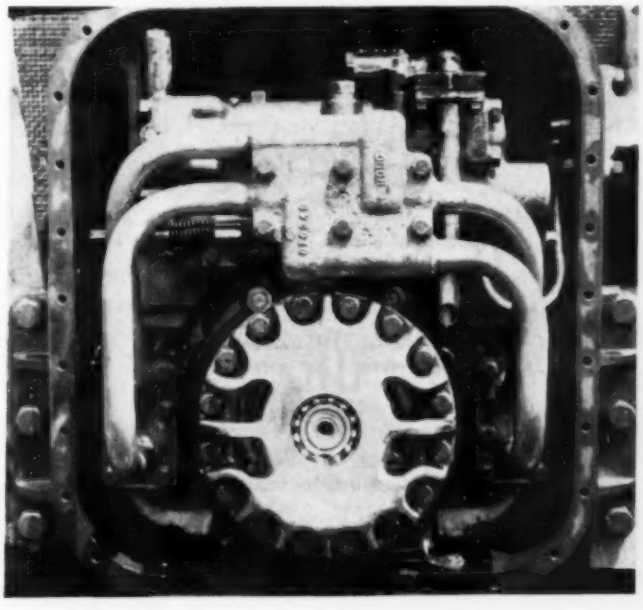
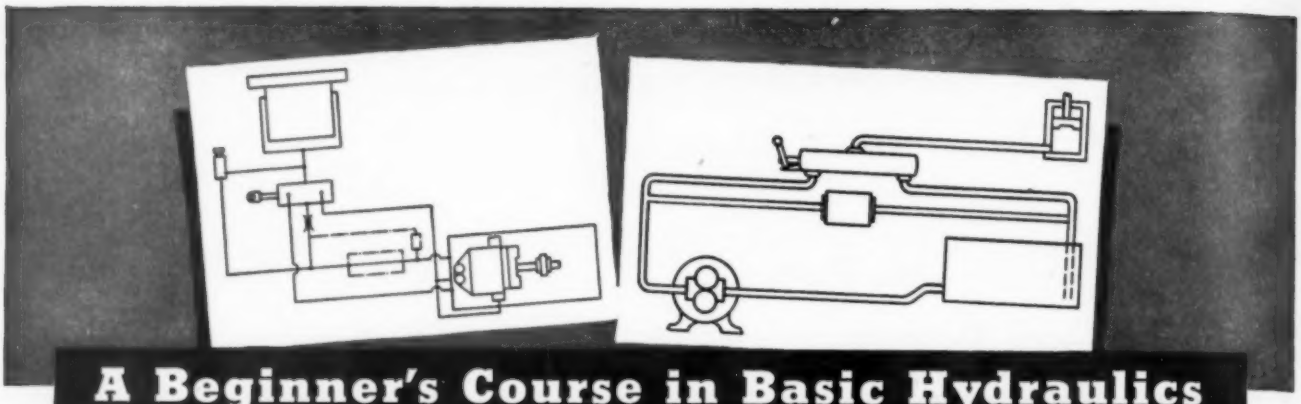



**Fig. 2. The unit used on the larger bulldozer is completely counterbalanced so that unbalanced loads in any direction do not result in the cylinder piston moving ahead of the pump outlet. To assure that the counterbalance valve not be actuated at the blind spot during movement of the control valve, the pressure in the cylinder power line is utilized to control the opening of the counterbalance valve.**





# A Beginner's Course in Basic Hydraulics

**Chapter VIII**

## HYDRAULIC PUMPS

**Part 2**

**External Type Gear Pumps**

EXTERNAL TYPE GEAR PUMPS MAY USE SPUR, helical or herringbone gears. The basic operating principle, illustrated in Figure 1, is the same for each style of gear tooth.

*Two meshing gears, A and B, are closely fitted in the housing. Gear A, the driver, is rotated by an externally mounted electric motor, and gear B, which is bearing mounted, rotates with gear A, in the opposite direction. Oil is carried around the periphery of the revolving gears from the suction to the discharge side. There is a continuous fluid tight joint between the two gears at their point of contact.*

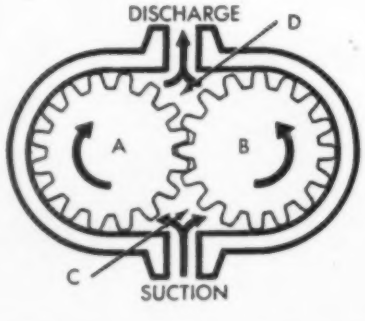



**Fig. 1. Meshing gears draw oil from the suction port, and oil is carried by the teeth between the housing and the gear to the discharge port. Discharge pressure is governed by the load on the pump.**

Gear pumps are positive displacement devices delivering a definite quantity of liquid for each revolution of movement. They are esssentially constant delivery because their output is fixed by physical size and speed of rotation. Their output will decrease slightly with increased pressure because of leakage back into the suction line. Leakage is a function of the clearances designed into the pump.

Normal hydraulic applications of gear pumps include pressure requirements up to 1500 psi and capacities up to 70 gpm. Fluid handling pumps are low pressure (0 to 300 psi) and high capacity (300 gpm).

**Mechanical design and construction features of pumps must be carefully considered because they determine the hydraulic performance of the unit.**

Spur and helical pumps are generally reversible in action. Herringbone gear pumps are not. Rotation in the wrong direction of herringbone pumps traps oil in the "v" to produce destructive back pressure strains.

Spur gear construction has the advantage of simplicity of manufacture. The higher cost helical gear offers quiet operation at high speeds and the tooth form permits delivery of relatively large volumes. Use of herringbone gears steps the cost up another notch to provide equalization of end thrust on the bearings and to minimize pulsations in the discharge line. As usual, application and cost are the determining factors in the choice between gear types.

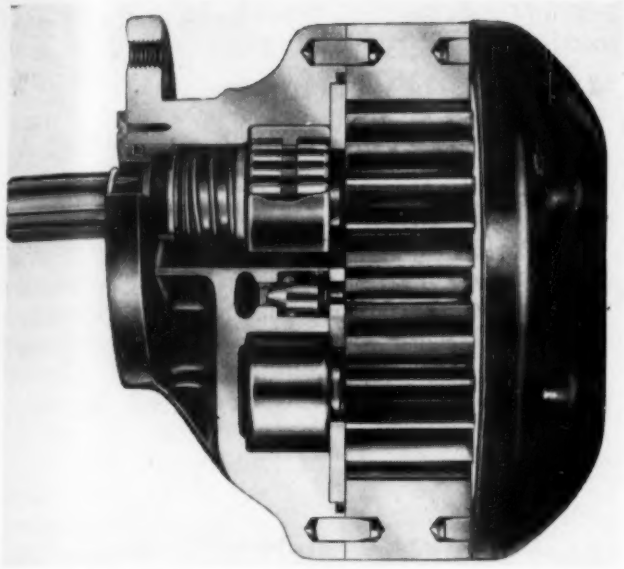


**Fig. 2. Spur gear pumps built for operating pressures up to 1000 psi find many applications on material handling and earthmoving equipment. Economy and efficiency is the result of simplicity of design and the selection of high grade materials.**
Hydraulic Equipment Company

There are many commercially available external gear pumps. Design variations between them include:

1. Selection of materials for gears, housings, wear plates and shafts
2. Type of bearings
3. Methods of tooth finishing
4. Gear tooth form
5. Size and shape of ports
6. Methods of fastening parts
7. Means of lubrication
8. Use of built-in valves
9. Type of oil seals
10. Mounting arrangements.

Many of these mechanical variations are governed by the particular pressure and capacity ranges for which the pump is designed. Other differences are based on design efforts of the manufacturer to improve certain characteristics of his pump.

Two types of commercially available gear pumps are described to illustrate basic construction and design ideas, for both high and low pressure pumps.

Figure 2 shows high pressure design for a spur gear pump manufactured by the Hydraulic Equipment Co. This four bolt design locates the assembly bolts within the area of greatest internal pressure, providing support where it is most needed to prevent distortion of wear plates and housing parts. A standard flange type mounting is illustrated; other flange and base mountings are made. The illustration shows the use of bronze wear plates to take the end thrust of the gears; anti-friction roller bearings to support the gear ends require a minimum of space; the shaft oil seal is used to prevent leakage and keep dirt from entering the pump cavity. The built-in check valve which discharges into the low pressure side regulates lubrication of the bearings and shaft seal.

**Fig. 3. Helical gear design provides a pump with a high capacity rating. Ths 300 gpm pump is widely used for fluid handling applications. Construction features are primarily determined by required operating pressure and capacity.**
Geo. D. Roper Corporation

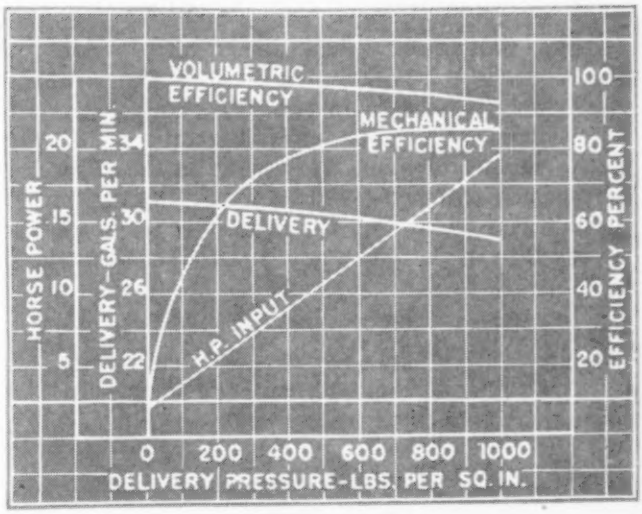



**Fig. 4. Typical performance curves of a gear pump provide the user with a guide for selecting a pump which will meet his requirements. Each gear pump design will have its own performance characteristics.**

This pump series offers a continuous operating pressure of 1000 psi at 1200 rpm. Six sizes provide capacities of 15.5 gpm to 64 gpm.

Materials used in the design of this pump are determined by the requirements set by the maximum operating pressure. Ground alloy steel spur gars are used. Cut gears are only satisfactory for low pressure service. The high-grade, high-pressure pump uses roller bearings. On low pressures needle bearings are used and where light loads are encountered sleeve bearings will prove satisfactory. Pressures, of course, influence the selection of wear plates and housing materials.

One of the several lines of gear pumps made by the Geo. D. Roper Corporation is shown in Figure 3. This particular pump is a low pressure (60 psi) fluid handling unit. Its application permits the use of sleeve bearings. No wear

*(Concluded on page 44)*

A Hydraulic Engineer Presents . . .

# The Evolution of a Circuit

By HOWARD FIELD, JR.

**Problem:** Apply a hydraulic system to a lathe for longitudinal feed only.

**1.** The tool feeds from right to left. When the tool is in the position shown in solid lines, the forces on the tool from the work are as shown. A force must be applied to keep the tool moving to the left. However, somewhat later when the tool has reached the dotted position, the longitudinal component of the force on the tool has reversed in direction so now the tool must be held back.

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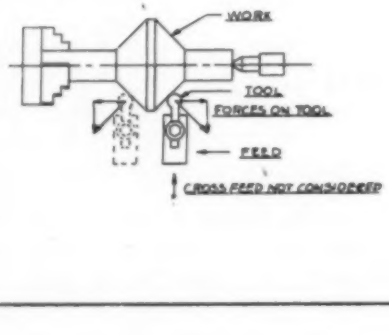
(1)

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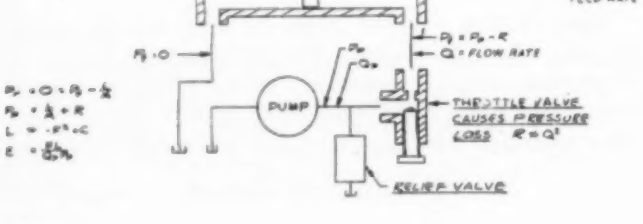
(2)




**2.** The simplest possible hydraulic system is a pump, relief valve, throttle valve, cylinder and a reservoir. The rod connects to the tool carriage and the load from the tool is shown applied to the left end of the rod. This is the condition existing with the tool in the position shown in the full lines in Figure 1. The pump draws fluid from the reservoir and discharges to the throttle valve. The relief valve prevents development of excessive pressure by returning unused fluid to the reservoir. The fluid which passes the throttle valve enters the cylinder to the right of the piston and moves it to the left. Fluid in the left end of the cylinder escapes to the reservoir. The area of the piston and the working pressure at which the relief valve is set are determined by the maximum force to be exerted under any conditions. The capacity of the pump is set by the maximum rate of tool movement ever necessary. Both maxima seldom occur at the same time but provision must be made for both. It may be assumed that in this problem the tool is fed at half the maximum rate, and L is half of the available maximum. If line losses, mechanical friction, etc. are neglected, Pr, the pressure in the return line, is zero.

*When the tool has advanced to the dotted position of Figure 1, the tool force reverses in direction, and since there is no way to maintain any pressure in the left end of the cylinder the tool "runs away."*

**3.** In Figure 3 the throttle is moved to the return side of the cylinder. Now Pr, instead of being zero, is equal to R, the pressure loss in the throttle, and when the tool tends to run away, a pressure is available to hold it. Here the pump pressure Pp, which is constant because of the relief valve, and the feed pressure Pf are the same and must equal $L/A+R$. Since the assumed feed is half of that provided for, half of the fluid must be going through the relief valve. Also, since the assumed load is half of that provided for $L/A=\frac{1}{2}$ and so R must equal $\frac{1}{2}$. It is important to consider the efficiency of the circuit.

The efficiency equals FL over QpPp. For the given condition efficiency is ½ × ½ or 25 percent.

*Efficiency is low and feed rate is variable.*

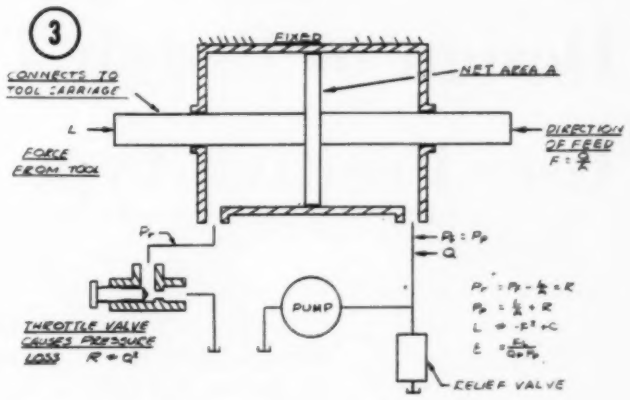
**4.** It may be seen that the feed rate depends upon the rate of flow through the throttle valve. This in turn depends upon the pressure drop across the valve so if a constant pressure drop is maintained, a constant feed rate will result. Figure 4 shows the same circuit with the addition of a pressure regulator to hold the pressure, applied to the throttle, constant. Here the fluid coming out of the return end of the cylinder enters the upper port of the regulator, flows through it and to the inlet of the throttle. As pressure builds up in the regulator outlet line, this pressure is transmitted to the right end of the regulator piston valve tending to move it to the left. This motion, which gradually closes off the inlet port, thus increasing the pressure drop across the valve, is resisted by the spring so the piston comes to rest when the pressure force and spring are in balance. If the outlet pressure tends to increase, the piston valve moves over thus further choking off the inlet. Hence, there is now a substantially constant pressure at the throttle inlet which will pass a constant rate of flow. Not only has a constant feed rate been obtained when the tool is resisting movement, but also when it is being held back.

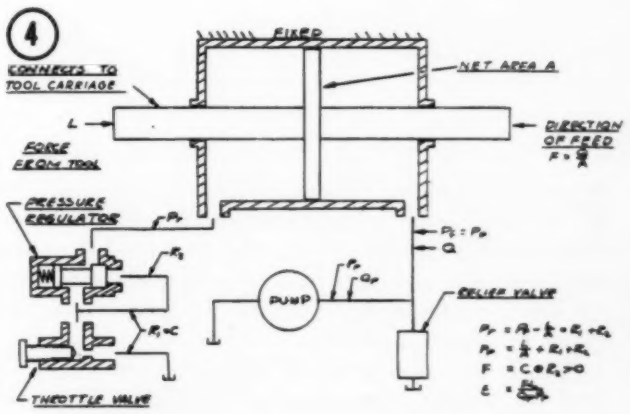
*Efficiency is still too low.*

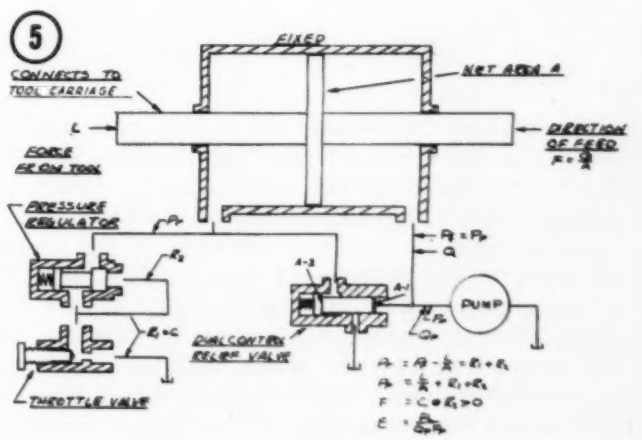
**5.** One more change may be made in an attempt to improve the efficiency. Figure 5 shows this change. The feed rate control is just as it was; however, the relief valve has been changed to a tricky affair with dual control. Here the pump pressure is applied to $a_1$ on the end of the plunger and Pr is applied in the same direction to the area $a_2$ on the head of the plunger. The sum of the two forces is resisted by the spring so that if either tends to increase, fluid is bypassed to the reservoir. If areas $a_1$ and $a_2$ are made equal, each will have the same effect. Now $Pp=L/A+R_1+R_2$, just as before except that neither side of the equation is constant. Pr equals $R_1+R_2$ and will be constant because any change will alter the amount of fluid being bypassed and thus change Pf. With $R_1+R_2$ constant, any change in L/A will change Pf just enough to compensate, so now the pump only puts out enough pressure to overcome the load. The efficiency is now ½×½/1×½ or 50 percent; twice what it was. That the efficiency should remain constant is evident from the fact that the term L/P has become constant. This leaves efficiency dependent solely on the feed rate.

*This article was prepared from a paper presented by Mr. Field at a meeting of the Committee on Hydraulic and Pneumatic Systems, ASME, Southern California Section.*

**Howard Field, Jr. is an engineering consultant in Los Angeles. For the mechanical hydraulic engineer, Mr. Field presents some of the basic steps and difficulties encountered when designing a circuit for a typical oil power application. While there are other ways of solving this problem, this example was chosen because it illustrates "Design Thinking". "Economic Thinking" has not been attempted although it is even more important.**



By M. J. PHILLIPS

# Design of Piston Type Accumulator Uses Positive Type Pressurized "O" Seals

A seal must prevent leakage and intermixing of oil with the gas charge, and it must not introduce high friction forces on the moving piston. To meet these requirements, a simple, ingenious design provides a well lubricated seal with a higher sealing pressure than the existing pressures on both the gas and oil sides of the piston.

PISTON TYPE ACCUMULATORS ARE COMING INTO general use in aircraft hydraulic systems. This trend is predicated on the fact that the latest low temperature operating requirements have not been successfully met by the other available types of accumulators.

While the piston type accumulator gives the best immediate promise of a satisfactory low temperature operating unit, it has certain functional draw backs. The one difficulty that is considered most objectionable by many users, is the inability to obtain an absolute seal between the gas and oil sides of the accumulator chamber.

## Drain Oil From Gas Side

Leakage of the oil past the piston seals usually results in the frequent need for draining this oil from the gas side of the accumulator. Drain location and accumulator mounting in the aircraft must be such as to enable removal of the excess oil from the gas chamber of the accumulator, with a minimum loss of the gas charge. Under the most adverse conditions, it may be possible for the gas to leak past the piston seals and enter the hydraulic system. Under certain circumstances this would be detrimental to the proper functioning of some units, for example, the hydraulic brakes.

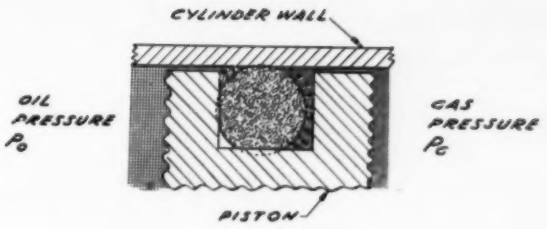
The use of the multiple chevron type seals in the accumulator piston has not been generally considered by designers because they are costly to install and they introduce operating friction without assurance of absolute fluid tightness.

## Pressure Differential on Piston

The "O" ring type of seal is given more favorable consideration and is more widely used because it is cheaper to install and gives more effective sealing as long as the integrity of the seal is maintained. The main weakness of the "O" ring is that it cannot be used in multiples as is the chevron type of seals since such use introduces considerable operating friction to the piston. In addition, the effectiveness of the single "O" ring to seal is poor when the pressure on both sides is identical. This is usually the case in an accumulator. One of the major design problems in developing a piston type accumulator using "O" ring seals is to avoid identical pressures on both sides of the seal.

The principle of "O" ring sealing and a step-by-step design of the piston type accumulator is shown on the following page.

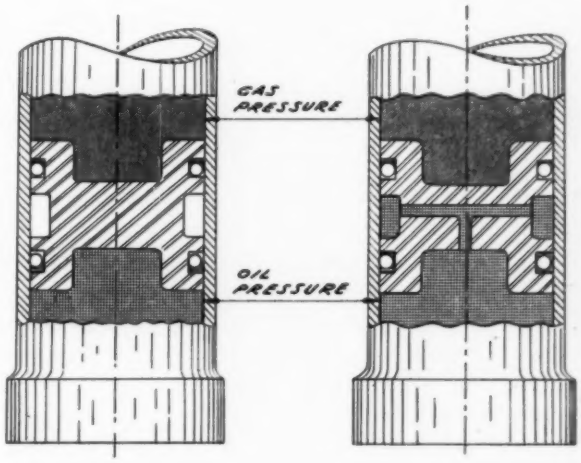
**THE MOST EFFECTIVE** sealing obtainable from the "O" ring is shown in Sketch 1 where the gas pressure $P_G$ is greater than the oil pressure $P_O$. In an accumulator these two pressures are usually very close to or have the same value. The introduction of high hydraulic impulses into the accumulator would cause the oil pressure $P_O$ to exceed the gas pressure $P_G$. Where such conditions are repetitive, seal tightness and seal life become questionable.




*Sketch 1*

**THE INTRODUCTION OF TWO "O" rings** on a piston, as in Sketch 2 is not considered good design because the wiping action of one seal results in a dry smooth surface for the second seal to slide upon. Under this condition, the second seal produces considerable friction and its life is shortened as well.

To offset this condition, some designers introduce oil to both seals, as shown in Sketch 3. This reduces the friction when using two "O" rings but in effect reduces the effective seals to only one seal, because the lower ring will always have identical oil pressure on both sides, while the upper ring has gas pressure on one side and oil pressure on the other.

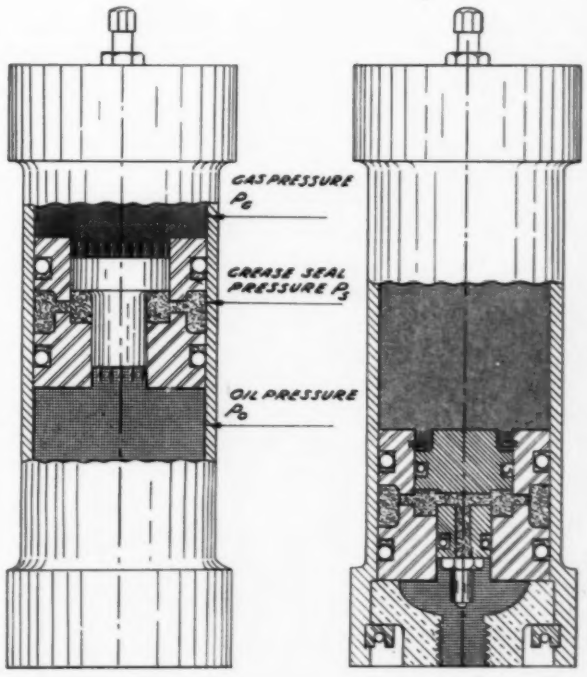



*Sketch 2* *Sketch 3*

**TO CORRECT THE WEAKNESSES** in the "O" ring sealed piston accumulator, a design has been made whereby two "O" rings are used with the pressure always greater on the one side at all times under operating conditions, Sketch 4. Two "O" rings are placed on the piston with a chamber between them, into which a low temperature grease is forced by means of a grease gun through an appropriate fitting with the piston in position as shown in Sketch 5 and having a small gas precharge.

**A SECONDARY PISTON IS ASSEMBLED** within the main piston in such a manner as to produce a higher unit pressure to the sealing and lubricating grease than exists at any time in the gas or the oil sides of the accumulator piston. This differential secondary piston which establishes the greater grease pressure, is a simple application of Pascal's Principle.

By such a device, the use of dual "O" rings can be successfully accomplished, with good lubrication to both seals and to the secondary seals shown in Sketch 5 and yet provide two full sealing mediums between the gas and oil sides of the accumulator.




*Sketch 4* *Sketch 5*

By LEE H. CRUSE

# OUTPUT TRIPLED WITH AIR

Mechanical ingenuity coupled with wise selection of air components provides accurate feeding of nails and power for the nailing operation.

DESIGNERS OF AUTOMATIC NAILING TOOLS MUST remove the costly losses due to bent nails, split wood and tediously slow production which are so common to hand assembly.

The Crusota Engineering Co., of Springfield, Missouri, broke a nailing assembly bottle-neck of hooked rug needles by designing and building air-operated nailers for the Wilson Bros., Co. The machine has increased production 3 to 1 and has practically eliminated bent nails. Definite pressure setting of nails and accurate part alignment has been accomplished.

This job requires the nailing of the two steel brackets, shown in Figure 1 at the base of the machine, to hard cherry wood parts. Holes in the brackets are prepunched .004 larger than the nail diameter, making location of the part in the nailing press very critical.

The brackets are first slipped over the wood parts and located by eye, in relationship to small indentations in the wood. These indentations are made during the shaping of the wood. The hooked rug needle handles are placed on the nailer table, Figure 1, guide plates straddle the sides of the steel band to accurately locate the piece under the two nails which are fed from hoppers. Air hammers perform the nailing operation.

Mechanisms for the positioning of the nails and the nailing punches are powered by air from the shop line, making the nailer a very versatile bench tool.

**Having in mind what the machine was designed to do, here is what happens to the nails from the time they are loaded into the hoppers.**

About 300 nails are located into each hopper at the top of the machine. A small low speed gear head motor drives eccentric arms through a ladder chain shown in Figure 2. These arms agitate the hoppers in an up and down motion to put nails in proper position to be fed to the hammers.

On each up-stroke of the press, one nail from each hopper is deposited into the nail tubes. They drop through the tubes into jaws located directly above the work. Nails can be seen hanging from these jaws in Figure 1.

Moving the nails from the mouth of the hopper slot to the nail tubes is done by the spring returned cams shown above the tubes. These cams, called nail carriers, are moved inward by the spring pressure when the nailing cylinder moves down. The carriers pick up nails from the hopper. When the nailing cylinder ascends, the collar which is fastened to it pushes the carriers outward. The carriers move the nails over to and deposit them in the tubes allowing them to be positioned in the bottom jaws ready for the nailing blow.

The two nailing punches are actuated by the main 2 in bore air cylinder. As the punches descend they contact the nail tubes and push them outward. The tubes are moved against torsion springs shown in Figure 1. The movement of the main cylinder is controlled by a 4-way foot valve.

As the punches approach the nails, a micro switch is tripped by a cam face on the punch holder. This switch energizes the solenoid-operated 3-way valve which controls the motion of the two midget single acting air cylinders. The downward travel of these cylinder pistons move, by cam action, two jaws which close on the nails to position them in exact alignment with the prepunched band holes.

Punches now contact the nails starting them into the wood. When the punches are a slight distance above the positioning jaws, the solenoid operated valve is de-energized, the small air cylinders retract and the jaws open, admitting the punches between them. The nails are driven straight and set at a definite pressure.

Air offers high speed and rapid control for feeding the nails and nailing. The main cylinder operates on a line pressure of 160 psi, giving nail

# DRIVEN NAILS

setting pressure of 500 pounds. Midget cylinders are operated on 30 psi line pressure.

Note that exhaust air is directed from the 4-way valve through copper tubes to the nails coming from an inclined plane at the hopper to the carrier. This air assures movement of the nails. Speed control valves in the circuit cushion the stroke of the air cylinders, and assure proper timing.

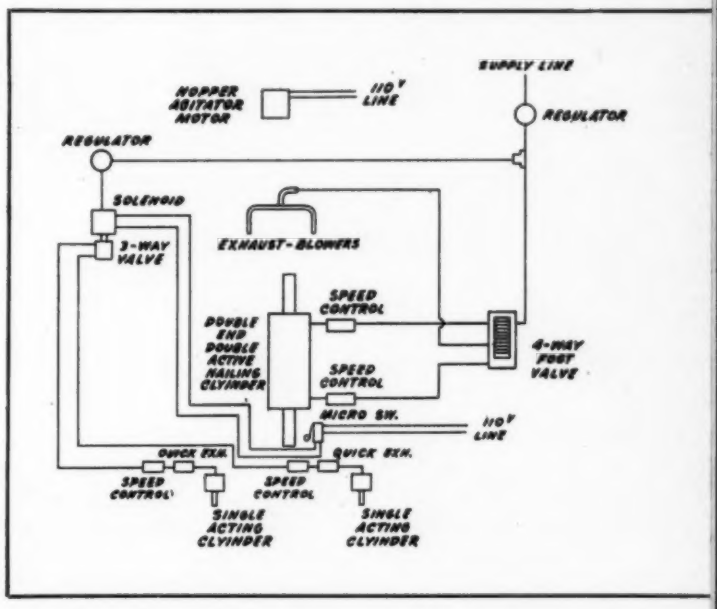



**Fig. 3. A 4-way foot valve supplies air to the double acting nailing cylinder. Automatically controlled by a micro switch, the 3-way valve directs air to the midget cylinders which move the nail locating jaws.**

**Fig. 1. Hand assembled parts are placed on the work table of the nailing machine. Nails are fed from the hoppers down tubes to the punches. The steel bands shown in the front are nailed firmly to the hooked rug needle handles by punches actuated by the center air cylinder.**

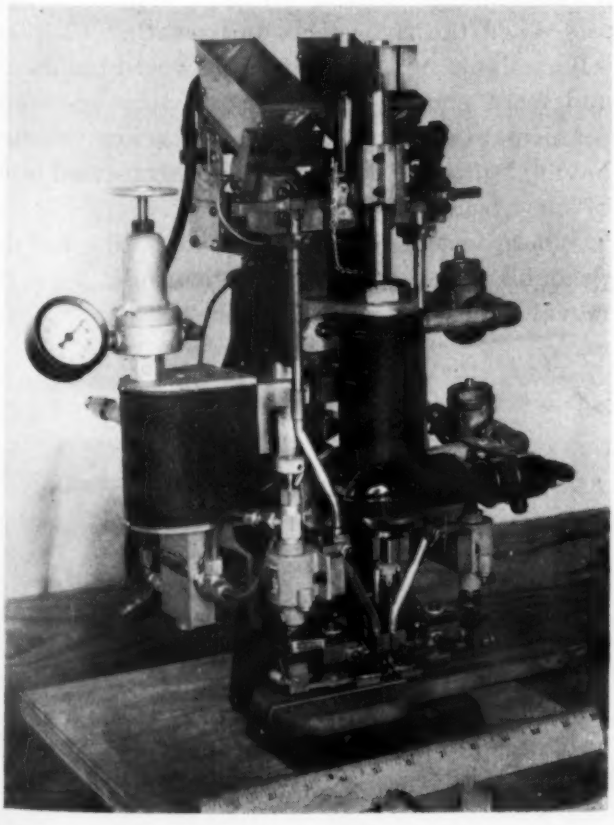
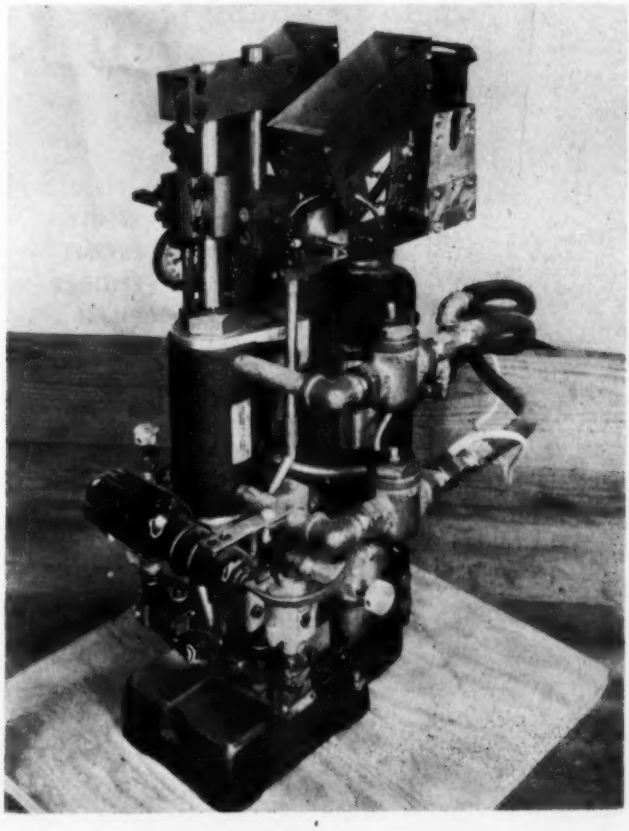


**Fig. 2. The two hoppers at the top of the nailer are agitated by motor driven eccentric arms moved by the ladder chain. One nail from each hopper is deposited in each tube during every cycle. The midget cylinders open and close jaws which properly locate the nails above the work.**



# SNOW . . . thousands of tons moved with oil . . .

**DOZERS SHOVED . . .**

OIL POWER WORKED AROUND-THE-CLOCK IN Cleveland's Big Snow of 1950. Heavy duty cylinders raised and lowered front end loaders, guided bulldozer blades and slid tons of snow out of upended dump bodies.

Rugged hydraulic units helped move the 22 inches of snow which had stopped traffic, shut-down industry and given school-kids an unexpected vacation.

On a Saturday morning in November, a highly motorized community found itself incapable of movement—old dobbin and his sleigh had been sold down the river for a fair weather Cadillac. All available tractors with oil powered bulldozers and front end loaders were put into operation. Municipal service trucks and contractors vehicles, having hydraulic dump mechanisms carried loads of snow from the city's streets.

Where fast action, high load capacity and dependable service are needed, hydraulic snow removal equipment does the job!

**WHILE FRONT ENDERS PILED . . .**

**AND LOADED . . .**

**AS FAST AS TRUCKS COULD DUMP**

# "When the Snow Flies!"

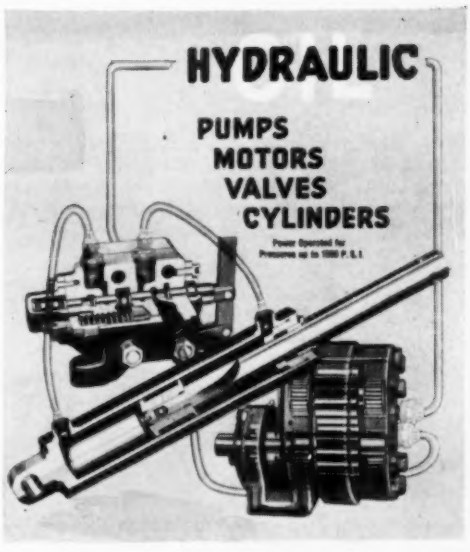
## "COMMERCIAL" OIL HYDRAULIC PRODUCTS

## MOVE INTO ACTION

If the snow plow equipment you have is controlled by "Commercial" Oil Hydraulic Products, you have a material possession for which it will be extremely difficult to find an acceptable substitute.

On any new equipment you require you will want to investigate the outstanding features of "Commercial" Oil Hydraulic Products.

Specify —"Hydraulics by Commercial," Quality — Thru and Thru.

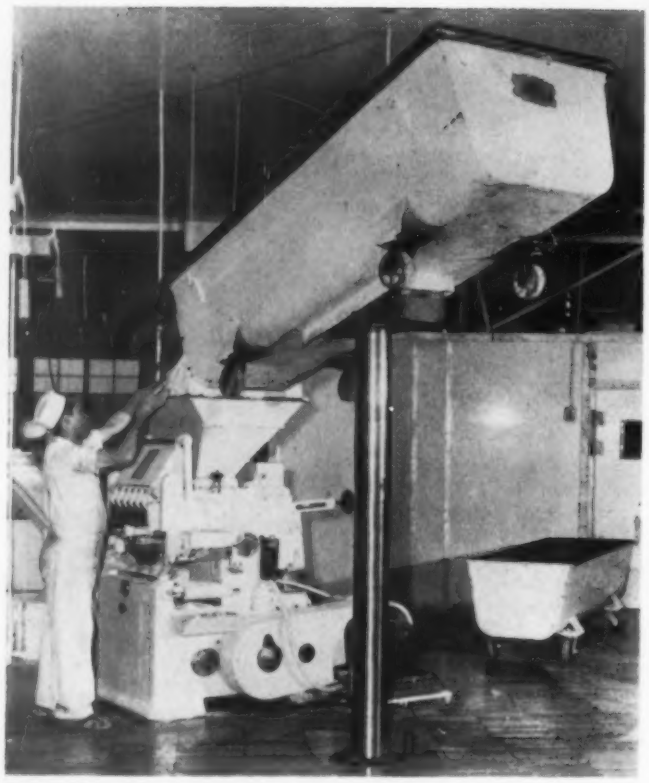



WRITE FOR DETAILED DESCRIPTIVE LITERATURE

QUALITY IN EVERY TURN

The COMMERCIAL SHEARING & STAMPING COMPANY
YOUNGSTOWN 1, OHIO.

**PAPER IS FED** to the shear from this working height lifter. The table is powered by a self-contained oil power unit consisting of an oil-reservoir pump, relief valves, filter, check valves and solenoid operated positioning valves. The table is easily loaded from a fork truck.



**DOUGH SLIDES FROM** the trough into the hopper, which has been raised from floor level. A special head, on the lift, locks in the base of the trough. The lift requires ten feet of depth below floor level. It eliminates hazardous overhead structures and presents no problem of dirt in the bakery.

**LONG, AWKWARD-TO-HANDLE** steel stock is readily transported by this combination fork truck, straddle buggy and motor truck. Hydraulic stabilizer jacks, which are retracted for traveling, will hold the loader while the lift forks raise a load.

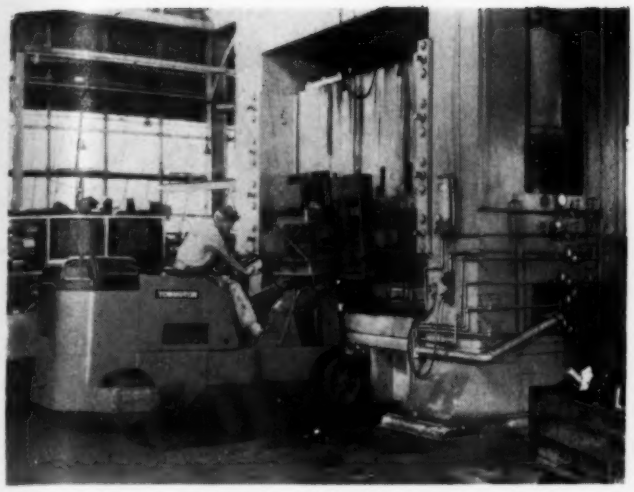
# Fluid Power Gives Muscles T

PLANT ENGINEERS ARE ALWAYS LOOKING FOR better, more versatile handling equipment which will get materials to machines on time, without disturbance to production and with a minimum of labor costs.

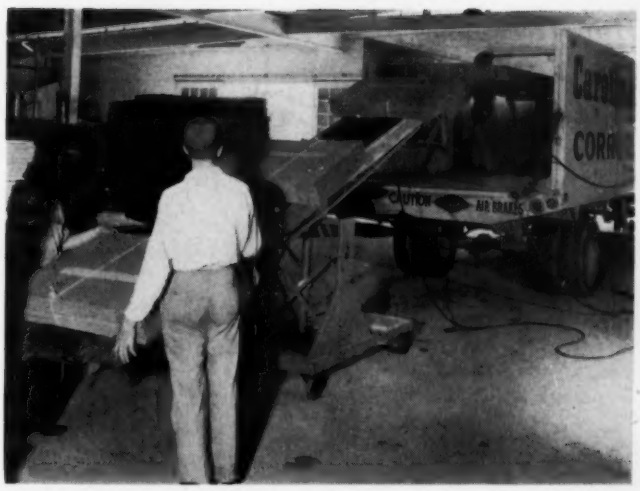
**Look to oil powered units for results.** They provide precise control for the lifting and tilting of heavy loads. Hydraulic cylinders controlled by directional, check and flow regulating valves provide smooth starting, stopping and locking functions. Hydraulic operation is safe; it is efficiently protected from any excessive overloading.

**Save space.** Compact equipment for confined surroundings is provided by hydraulic systems because they offer efficient means of transferring power from its source to one or more points of application. A space-saving arrangement of components is made possible.

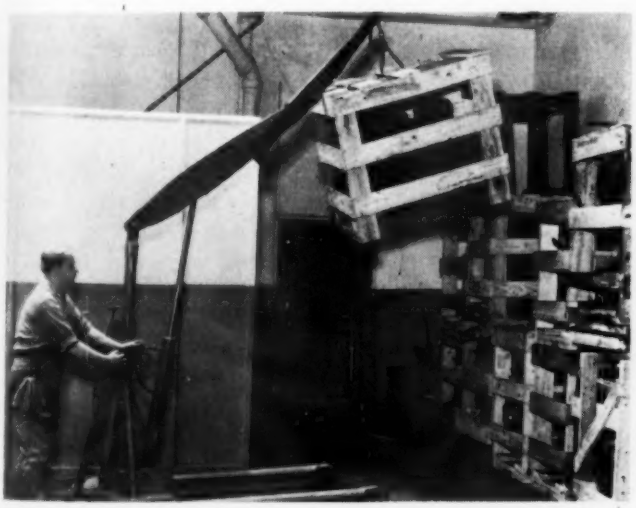
Hydraulic flexibility facilitates the addition of special handling attachments such as clamping



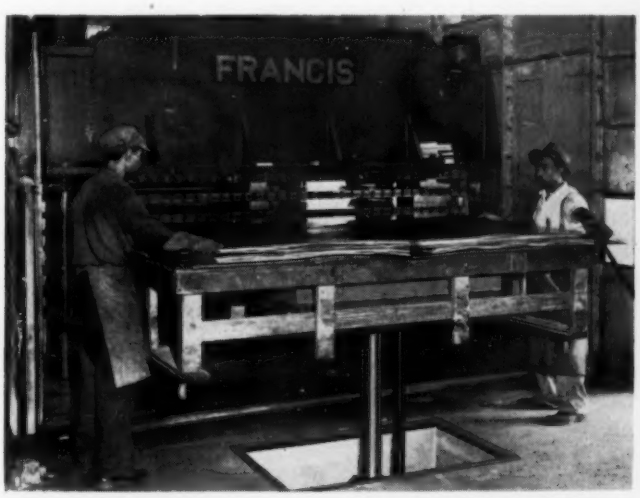
**POSITIONING THIS SIX** ton die on the table of a 1200 ton press at the Oliver Corporation is quickly accomplished with this fork truck. The operator can raise, lower and tilt the die by moving the hydraulic valve lever. He can rapidly move tools from storage to work area.



**TRUCK LOADING OPERATIONS** are speeded at the Carolina Corporation by using a hydraulically positioned conveyor, which is elevating carton stock for stacking. A hand operated jack moves the center lift to give a maximum travel of over two feet for loads up to three tons.



**HEAVY UNITS ARE** lifted with this oil powered crane. The cantilever beam is raised and lowered with safe, positive, fingertip control of the cylinder travel. Twelve different lifting heights may be obtained by adjusting the beam.




**SHEET FEED TABLES** can be positioned by a hydraulic lift, which in the down position leaves a clean level floor permitting the castered stock tables to be freely moved. All the oil power equipment is located away from valuable work space.

# To Material Handling Equipment

arms, dumpers, and rotating carriages.

The many available types of fluid powered equipment free labor for other work. One operator can easily maneuver loads; stack them, load and deliver.

In the press room, positioning of the materials at the work station must be done quickly and accurately. An elevating table brings sheet stock to shear blade level, cutting 30 percent from the time the shear man used to spend on handling. The die set-up man slides a die from a table onto the punch press platen. An upender moves a coil of stock on to a slitting machine.

**Reduce accidents.** On the loading dock, levelers and adjustable ramps meet the truck tail gate for safe, easy loading. Conveyors which are hydraulically located speed the flow of material.

In the stock room, cantilever cranes stack equipment, while lift trucks sort and position with less upkeep, less manpower and lower unit cost.

*How two users of costly synthetic hydraulic fluids . . .*

# Reduce Operating Costs with Purifiers

**Company: Stewart Die Casting Company**

**Type of fluid: Chlorinated Biphenyl**

THIS COMPANY IS ENGAGED IN THE MANUFACture of die castings for outside contractors. Their machines are "home built and manufactured" representing a diversity of types and designs. A large number of the machines are operated from a central hydraulic system with water as the actuating fluid. Several of the machines, however, are equipped with individual hydraulic circuits utilizing a hydraulic fluid other than water. Originally, these oil powered machines were operated with mineral oil as the hydraulic fluid. In recent years, however a change was made to a non-combustible synthetic comprising approximately 48 percent chlorinated biphenyl.

**Contaminants**

Due to the excellent wetting and penetrating action of this material, quantities of dirt, scale and rust which had accumulated in the machines during past service periods were flushed through the system and resulted in an epidemic of machine breakdowns due to damage to various machine parts. Particular damage was done to the vane type pump. Machine down-time to repair jammed pumps or replace scored shafts and other parts was excessive. Further, since the chlorinated biphenyls have a tendency to keep foreign matter in suspension, the situation became worse as the fluid accumulated additional contaminants.

**Use portable purifiers**

Upon the recommendation of a purification engineer, the company purchased and put into operation a portable purifier using processed Fuller's earth as the filtering media. A schedule was established in which the purifier was placed in operation on the hydraulic reservoir of each machine approximately one day out of each seven the machine was operating. The purifier was moved from machine to machine and completed a circuit of seven machines every seven days, which was then repeated.

Results were immediate, and although a few weeks elapsed before the maximum benefits of the program were realized, restoring and maintaining the hydraulic fluid in a clean contaminant-free condition has resulted in:

1. An approximate 75 percent decrease in maintenance costs.
2. Marked reduction in machine down-time and lower unit production costs.
3. An appreciable reduction in oil replacement expenditures.

**Company: Madison-Kipp Corporation**

**Type of fluid: Tri-cresyl-phosphate**

UP UNTIL THE EARLY 1940'S DIE CASTING MAchines in the Madison-Kipp Corporation's plant, were operated with an ordinary grade of straight mineral oil as the hydraulic fluid. In 1943-44, however, as part of the company's policy of eliminating occupational hazards the hydraulic fluid in the machines was changed to tri-cresyl-phosphate, a nonflammable synthetic fluid. This material has found extensive use as a petroleum substitute in hydraulic and other applications where a non-flammable fluid was desired. Although the company had previously followed a practice of reconditioning and purifying their mineral oil, the high cost of the synthetic coupled with an unusual contamination problem made reclaiming and reconditioning of the tri-cresyl-phosphate a must.

**Contaminants**

As in many hydraulic operations where forming, shaping or cutting of a metal is involved, lubricants are used on the working parts of the machine as well as in the hydraulic circuit. In many cases, conditions are such that the hydraulic fluid and "working" lubricant become intermixed as a result of leakage, bleeding, etc. In the particular operation carried out by the Madison-Kipp Corporation, the hydraulic ram is lubricated with a mixture of graphite and 600W oil. Leakage from the ram dropped onto the base plate of the machine and mixed with small amounts of leakage from the hydraulic circuits. The result was a mixture of tri-cresyl-phosphate, mineral oil, graphite, and occasionally small amounts of water. For most machines, hydraulic fluid losses amounted to three to five gallons per week, which unless reclaimed would neces-

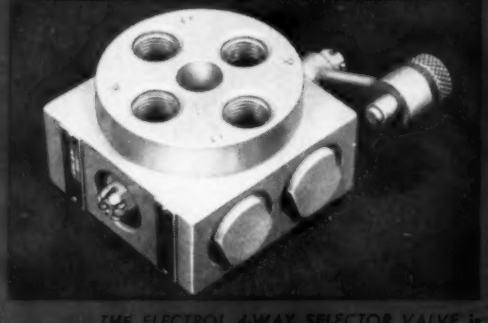
*(Concluded on page 59)*

Specify

# ELECTROL

## Hand Pumps and 4-Way Selector Valves

THE ELECTROL DOUBLE-ACTION HAND PUMP delivers uniform pressure and volume with stroke of handle in either direction. It has few moving parts, is low in cost, economical in operation, and requires but a minimum of maintenance. Operating pressure: 0 to 1,500 p.s.i. Pump delivery: 1.5 cubic inches per cycle. ⅜" N.P.T. ports. Suction and pressure check valves built in.



THE ELECTROL 4-WAY SELECTOR VALVE is compact in design, rugged in construction, and provides a simple, convenient means of directing flow to hydraulic actuators with low handle load. Its poppet-type construction assures positive performance without internal leakage. Operating pressure: 3,000 p.s.i., minimum. Ports: ⅜" N.P.T.

*Better Designed Products Use Electrol Hydraulics*

### Where Applications Call for POSITIVE PRESSURE and CONTROL

HAVE a machine, or device, that calls for positive pressure and control—but does not require automatic operation? The Electrol Hand Pump and 4-Way Selector Valve—when used *together*—provide an efficient, low-cost means of handling this type of application.

The Hand Pump, which is equipped with built-in check valves, supplies the necessary volume and pressure with a high % of efficiency. The 4-Way Selector Valve, connected to a hydraulic actuator, allows the operator to position *accurately* any part of the mechanism—and to lock it securely—simply by placing the Valve handle in neutral. Also, the leak-proof construction of the Valve prevents creeping or any departure from position.

We will be glad to supply you with further details on the use of these hydraulic devices, or work with you in adapting them to your particular design requirement. Your inquiry will receive prompt attention.

**Electrol**

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CHECK VALVES · RELIEF VALVES · HAND PUMPS
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FOR BETTER HYDRAULIC DEVICES

**FRED O. HOSTERMAN**
**Advisory Editor**

# Development of the Unloading Gear Pump

By ERNEST H. SCHANZLIN

THE INTRODUCTION OF THE CLASS 3000 PSI HYdraulic systems and variable volume pump control systems in aircraft during the middle 1940's presented the gear pump manufacturer with a tremendous design problem. To maintain his position as an accessory supplier it meant that he must develop first, a new line of high pressure pumps and second, a variable volume gear pump or equivalent unit which would operate satisfactorily in the popular variable volume pump control systems.

## Strengthen Parts for 3000 PSI Service

Refinement of the wearing parts and strengthening the body of the patented pressure loading type gear pump soon provided the industry with units to take care of the 3000 PSI hydraulic system requirements. Laboratory tests on these pumps showed volumetric and torque efficiencies over 90% at operating speeds between 1500 and 4500 RPM, and slightly lower efficiencies below 1500 RPM. Airline tests further proved the reliability of the units in that service lives of over 4000 hours were obtained between overhauls. The service test data also showed that the overall efficiency of the units actually increased during the first 1700 hours of operation and then gradually decreased during the remaining service life.

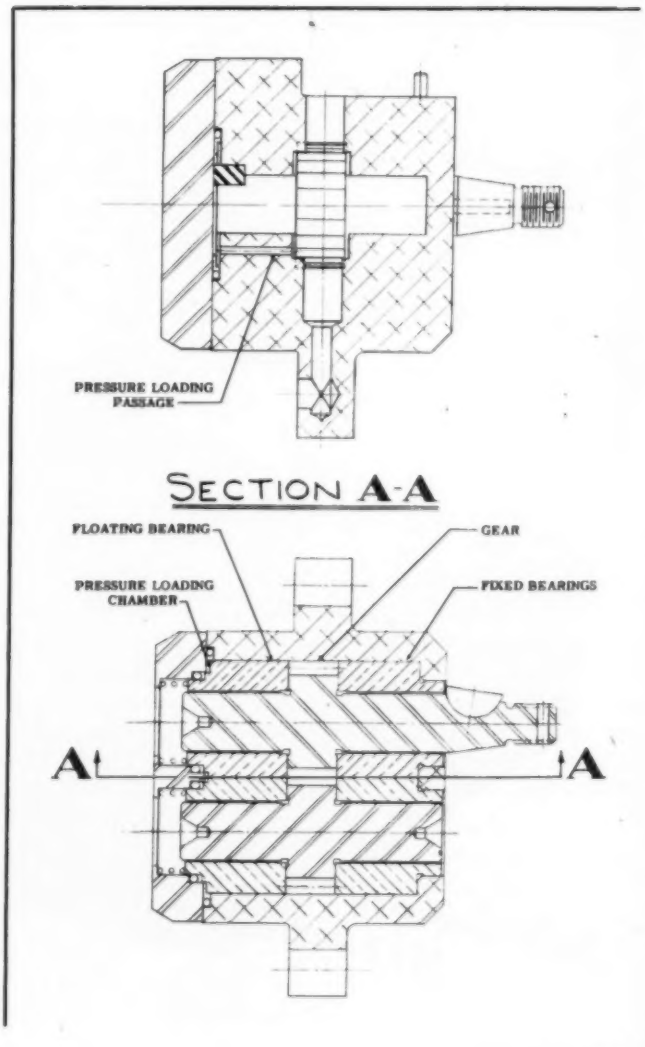



**Fig. 1. The basic pressure loaded gear pump uses pressure from the discharge of the pump to maintain a minimum end clearance between the gear and bearing faces.**

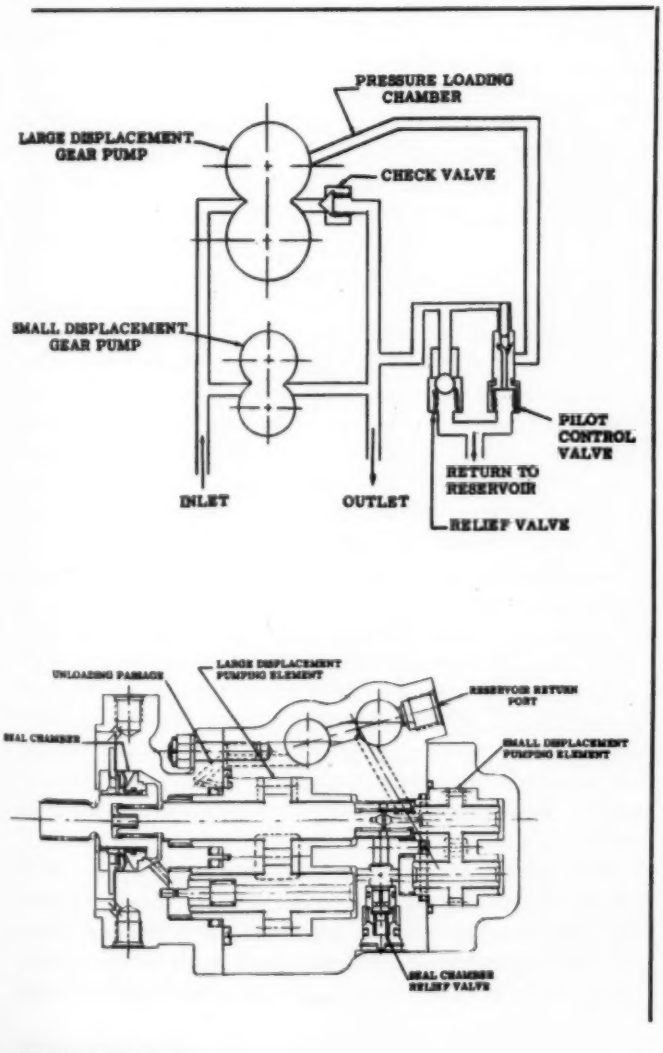
Although the class 3000 PSI pump requirements were met, the gear pump manufacturer was still faced with the problem of developing a unit suitable for the variable volume pump control systems. Unless he did this he would have to bypass a major portion of the business since many of the aircraft hydraulic system designers favored the variable pump control systems. This indeed was a challenge to the ingenuity of the gear pump designer.

## Gears Are Pressure Loaded With Oil

The first step in the development of a variable volume gear pump was to review the past art and augment it with possible improvements to build a suitable unit. An early scheme was worked out to incorporate the pressure loading principle into a sliding gear pump in which the driven gear was axially displaced in relation to the drive gear and proportional to pressure above a pre-set value. Tests soon showed that the complex design provided an excessive number of leakage paths and such a pump was impractical for the high performance requirements of aircraft pumps. Failure of the sliding gear pump then led to the conception of utilizing the pressure loaded principle to build a two-stage or step pump. Such a pump could include all the features built into the successful fixed displacement pumps.

The pressure loaded pump construction permitting this automatic unloading is shown in Figure 1. The pressure loaded pump consists of a matched set of gears and four gear supporting bearings assembled into a close fitting body and cover. Light springs are provided to hold the bearings in position until the pump is primed, after which the movable bearings are floated toward the gears by the hydraulic pressure from the outlet port. This pressure is transmitted through the pressure loading passage and exerted against the rear of the bearing flanges where an unbalanced force moves the bearings toward the gear faces so that the end clearance is limited to a film of oil. Although full operating pressure is applied to the rear faces of the bearings, this force is counter-balanced by the pressure developed in the gear cavity so that the thrust of the bearings against the gears is just enough to accomplish its purpose. Frictional wear on these parts is thereby minimized and maximum torque and volumetric efficiencies attained. Gear journals are lubricated by leakage from the high pressure area cavity along the gear shafts.

Inasmuch as pressure in the cavity behind the cover bearing flanges is utilized to float the bearings against the gear faces, it was believed this same principle could be used to unload the pump. Venting the pressure loading chamber to the reservoir or inlet line should permit the pressure in the gear cavity to float the bearing away from the gear faces until the maximum pressure build-up is equal to the spring loading forces on the floating bearings. Based on this premise development of the unloading type pump was initiated.




## Valve Determines Unloading Point

Figure 2 schematically illustrates the system developed. This system built into a typical unloading type pump is shown in Figure 3. As the pump is rotated, fluid is drawn into the individual pumping elements through a common inlet line and discharged through a common outlet line. During priming the bearing springs position the gears and bearings and as soon as pressure is developed it is transmitted to the pressure

**Figs. 2 and 3. A schematic of the unloading gear pump shows two pressure loaded gear pumps, one of large displacement and one of small displacement, with a check valve in the large pump outlet and connecting with the small pump by a common outlet, a pilot control valve for unloading the large pump pressure loading chamber and a relief valve for handling the small displacement pump output under a blocked line condition. Figure 3 shows a typical unloading type pump.**

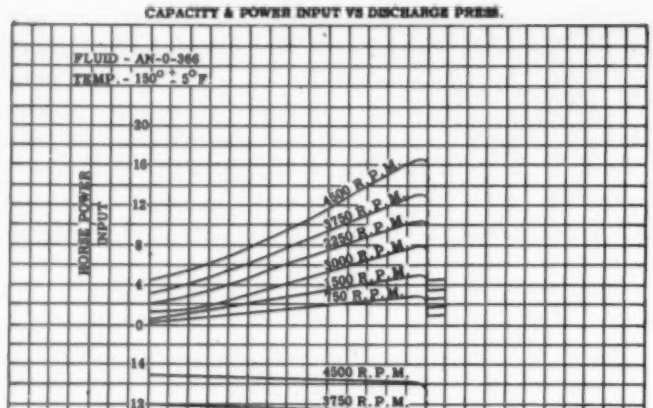



**Fig. 4. Typical performance of the unloading gear pump.**

loading chamber of each pump. This pressure loads the bearings against the gear faces. The large displacement pump unloading chamber is connected to a balanced valve controlled by the system pressure. This valve is adjustable and is set at a pressure compatible with system requirements. As the pressure is raised to the pilot valve cracking pressure, flow is bled through the pressure loading passage and pilot valve at full system pressure. Increasing pressure further opens the pilot valve and as soon as the loading chamber pressure falls below the pump outlet pressure the bearings are pushed away from the gear faces to unload the pump. Maximum pressure in the unloaded pump is then limited to that required to overcome the spring loaded bearings. Usually this pressure is in the neighborhood of 30 PSI.

## Built-in Relief Valve Protects Pump

While in the unloaded condition the pump circulates cooling oil through the pressure loading passage and pilot control valve to the reservoir. The check valve in the large pump outlet prevents fluid leakage from the system through the unloaded pump. The relief valve connected to the outlet port bypasses the small pump flow under a blocked line condition or partial flow when the system demand is less than the small pump output. To provide for safe failure and also eliminate the need for an additional system relief valve, the valve is designed to handle the full output of both pumps. This valve is adjustable and usually set approximately 150 PSI above the unloading pressure. Flow from the pilot control valve and relief valve is returned to the reservoir through a third port. Leakage from the high pressure cavity along the gear shafts is vented to the drive shaft seal chamber and maintained at a positive pressure by means of a small relief valve connecting with the inlet port.

## Power and Delivery Characteristics

*The maximum flow output as well as the unloaded pump output is usually designed in accordance with definite hydraulic system requirements. In the case of a continuous flow demand for a service, the small displacement pump must be designed to give an output slightly in excess of the demand, whereas, in the case of a zero flow demand, except for leakage past valves, the small pump is usually designed to 0.1 the total pump displacement or as small as practical.*

Figure 4 shows the performance characteristics of a typical pump. At constant speeds the respective curves show that flow decreases uniformly until the pilot control valve cracking pressure is reached and then drops off at an accelerated rate until the unloading pressure is reached. Conversely, the horsepower input increases uniformly with pressure until the pilot valve cracking pressure is reached and then continues to rise at a reduced rate until the unloading pressure is reached. Between the pilot valve cracking pressure and the unloading pressure the valve gradually opens and during this period a portion of the total pump flow is bled through the pilot control valve to the return port, and at the same time reduces the pressure loading of the bearings, thus accounting for the reduction in flow and indicated increase in torque efficiency. At the unloading pressure, flow is reduced to the output of the small displacement pump and the driving torque is similarly reduced. With a further increase in pressure the small displacement pump output flow is bypassed through the pump relief valve until zero flow is obtained. Conversely, output flow increases as the pressure decreases and the pump reloads to give the maximum output. Oscillograph tests in an undampened laboratory system, that is with metal tubing throughout, have shown that the unloading and reloading is accomplished in approximately .025 seconds with a maximum instantaneous pressure overshoot of 200 to 300 PSI above the unloading pressure as the pump is reloaded. The transition between the minimum and maximum flow pressures was controlled by a solenoid operated valve.

The performance curves represent those of a pump designed with a low friction, rapid opening and closing pilot control valve for maximum overall operational efficiency. Pumps incorporating such a valve are used when an accumulator

is installed in the hydraulic system. Without an accumulator in the system a slower opening and closing dash-potted pilot control valve is used to more closely simulate the true variable pump performance. The slower acting dash-potted valve effectively increases the interval between the cracking pressure and unloading pressures and also unloads the pressure loading bearings gradually to permit internal bypass of flow during the unloading and reloading cycles. Inasmuch as a portion of the high pressure flow is bypassed in the gear cavity and another portion is bled through the pilot control valve, a power loss must be accepted, therefore, the horsepower input required with the dash-potted valve does not fall off proportional to output flow and pressure until full unloading has been accomplished.

### Aircraft Service Tests

Another 66 hour flight test installation in the North American T-28 jet trainer airplane also gave satisfactory performance and showed a somewhat lower heat rejection into the hydraulic system than the piston type pump that it replaced. With the pump relief valve cracking pressure set at 1500 PSI and the pump operating at 3150 RPM at the end of a 45 minute flight the hydraulic system temperature leveled off at 125°F. This test was conducted with the system pressurized during flight, meaning that the small pump was operated at the relief valve setting or higher. These results are particularly interesting inasmuch as the hydraulic system engineers in many cases are concerned over the fact that the small displacement pump flow is bypassed through the relief valve when there is no-flow demand from the system.

The unloading pumps to date have given an excellent account of themselves in test installations. They have shown that they are functionally interchangeable with the variable volume pumps in various installations, that the heat rejection into the system under a no-flow demand is not objectionable and also that they are reliable.

### Performance in the Lockheed F-80

After extensive laboratory tests, the first flight test installation of the unloading pump was made on the Lockheed F-80 Shooting Star. To test for pilot reaction the Lockheed engineers installed the pump without the pilot's knowledge. During the flight test program the airplane was actually flown by several different pilots and in no case were 'sqawks' received in regard to the hydraulic system or power boost control operation. Satisfactory performance thus indicated that the gear type unloading pump in the F-80 hydraulic system is functionally interchangeable with the true variable volume piston pump in the same system.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performance charts FIRST

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- High pressure—3000 p.s.i.
- High capacity—3 g.p.m. at 1500 r.p.m., at 3000 p.s.i.
- High volumetric efficiency—96% at 2500 r.p.m., 3000 p.s.i.
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"Pressure Loading" which provides automatic compensation for wear on the bearing and gear running surfaces makes possible high efficiencies and long, trouble-free service life.

This pump has been service tested by several leading airlines and has operated, well in excess of 3000 hours, with no maintenance except recalibration and replacement of shaft seal diaphragms at engine overhaul time.

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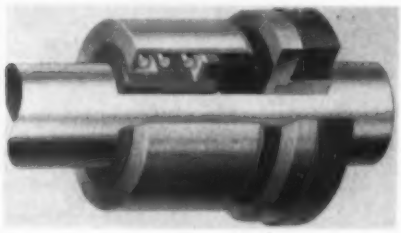
Circle 56 on Reader Service Card

# application and performance of NEW COMPONENTS

**MECHANICAL SEALS FOR ROTARY SHAFTS**—Sealing is effected by leakless and positive contact between carefully lapped metal-to-metal or metal-to-carbon mating surfaces on this rotary shaft seal offered by the Garlock Packing Company. One of these elements rotates with the shaft and the other is stationary. The stationary element does not contact the shaft. These precision-built seals are made in several standard designs and in a wide range of highest grade materials. The selection of design and materials depends upon the service in which the seal is to be used. If none of the standard designs appears entirely suitable for any specific application, a modification of a standard design or a specially designed seal will be engineered and built for that job.



Circle 101 on Reader Service Card

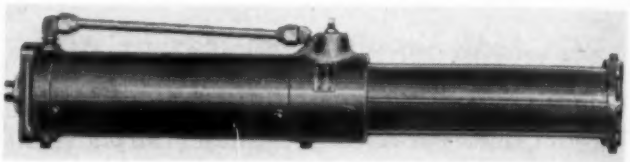
**RUST PREVENTIVE**—Safe-pHilm, rust preventive is a new dark-colored, solvent type, organic metal preservative. Especially developed by Swan-Finch Oil Corporation, for the protection of highly finished surfaces, parts and equipment prior to storage or shipment. It is a fast drying rust preventive which forms a colored, yet transparent film, within 15 minutes. Film is removable with kerosene or solvent. It is noted for forming a tough elastic polar film with the ability to resist acids and alkalies and abrasion.

Circle 102 on Reader Service Card

**AIR AND OIL VALVES**—A line of valves for actuating air or hydraulic cylinders has just been introduced by Ledeen Manufacturing Co. Valves embody the rotating disc construction and are made in three types; for hand-operation, foot-operation, and finger or solenoid operation. This group of valves is available in 14 different models and 6 sizes and may be used for controlling the flow of air, oil or water. The hand-operated valves turn 45 degrees each way from neutral, a total of 90 degrees. The finger or solenoid-operated valves are actuated by two single poppets, are depressed about ⅛ in by light finger touch. Only two small solenoids are required to actuate the poppets and require only momentary energizing.

Circle 103 on Reader Service Card

**AIRDRAULIC CYLINDER**—Many cylinder applications require the controlled feed attainable with oil and the fast action which air provides. Logansport Machine Co., Inc. offers AirDraulic cylinders for these applications. The cylinder is an integral unit consisting of an air piston and a hydraulic piston mounted on a single rod. The thrust or pull of the rod is obtained by means of the air cylinder, controlled by a valve or valves in the usual manner. The two chambers in the hydraulic cylinder are connected externally in a self-contained circuit; an adjustable speed control valve regulates the flow of oil and hence the speed of the rod stroke. The hydraulic circuit is self-contained and no power unit is required.



Circle 104 on Reader Service Card

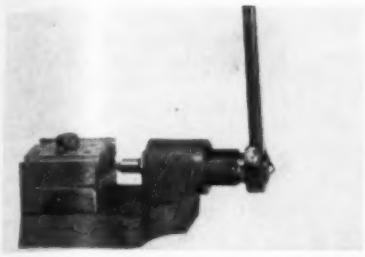
**HIGH PRESSURE SWITCH**—The Bondee high pressure precision switch, offered by the Alloy Bellows Engineering Co., has been developed for use where close control of pressure is essential and is particularly suitable for use in many hydraulic applications where it is necessary to have a switch which will repeat accurately, or one which must control low pressures and also withstand a high over pressure. The pressure element in this control is sensitive to pressure change from 0 to 3000 psi. This totally enclosed, explosion resistant switch is made of aluminum and also available in brass or stainless steel.

Circle 105 on Reader Service Card

**INJECTION MOLDED SILICONE RUBBER**—Minnesota Rubber & Gasket Co., has announced a successful method for injection molding silicone rubber. This process is an adaptaton of their standard injection molding machines wherein the silicone rubber is forced into the cavities of the mold under high temperature and pressure. This process is applicable for relatively small molded parts where the manufacturer requires either extreme temperature characteristics or high dielectric for insulating purpose. Injection molded silicone rubber is adaptable for grommets, seals and bushings as well as other mechanical parts.

Circle 106 on Reader Service Card

**TUBE FLARING DEVICE**—The Knuth Engineering Company has introduced the Handy Expando, tube end expander and flaring tool for use in the installation of hydraulic systems, and other installations where tubing is used for transmission of fluids or gases. This new device will either expand or flare the ends of soft and hard copper, aluminum and steel tubes with just a few turns of the Expando's handle—within seconds after the tube has been placed in the jig. Present models, weighing less than ten pounds, come equipped with the dies necessary for the expansion and flaring of ⅜, ½, ⅝ and ¾ in tubes.



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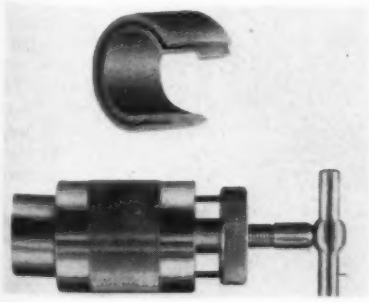
**MOTOR STARTER**—Protection of operating personnel as well as the connected machine is stressed in a new motor starter, the Motor Watchman, Class 10-100-S1, available from Westinghouse Electric Corporation. With ratings up to 600 v, 7½ hp polyphase, 5 hp single phase; or 220 v, 1½ hp dc, it starts, stops, and provides overload protection for single phase, polyphase and dc motors. The self-indicating handle, interlocked cover that prevents opening unless starter is "off", and safety latch to lock starter "off" during servicing are personnel-protection features.

Circle 108 on Reader Service Card

**PACKING FOR HEAT EXCHANGER TUBES**—A new packing and packing installation tool, both special equipment to a unique new method for sealing tube sheet closures on heat transfer equipment for use with corrosive fluid, have been introduced by Greene, Tweed & Co. The packing is of molded composition and is available in compositions that match the service. This packing, cut to show a cross section, is shown above the tool. The special tool consists of two screw drives, the tightening of one causing the tool to grip the edge of the packing and the tightening of the other driving a cylindrical blade forward into the annular space where it contacts the filler ring and, advancing, distends the packing. This stretching thins down the packing walls and so enables the packing to pass over the end of the exchanger tube and to be inserted in the tube sheet opening. When the packing is in place, the tool is removed and the packing, recovering its shape, expands in the opening and exerts sealing pressure.



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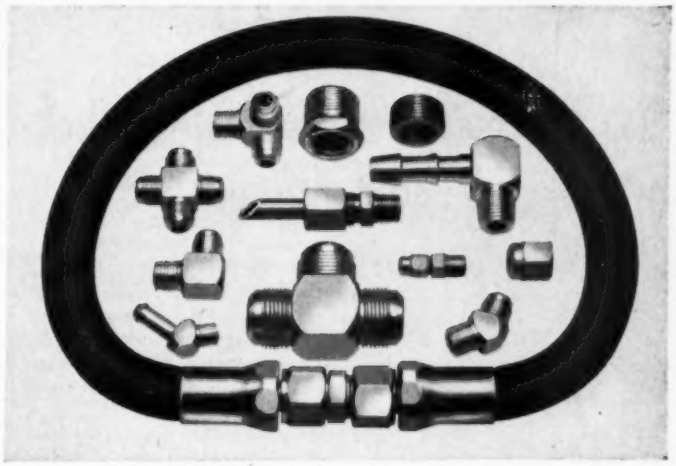
WHEN YOU CHANGE TO

# J. I. C. Standards

LET L & L SERVE YOUR HYDRAULIC PIPING NEEDS



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  for ⅛th to 2 inch O.D. tubing
  2 PIECE TITE-SEAL FOR ECONOMY
  3 PIECE LOCK-JOINT-SLEEVE TYPE

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  with pressed-on coupling for single and double wire braid hose

- **PIPE FITTINGS**

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- **PRE-FABRICATING TUBES**

  Let us estimate your preformed tube assembly needs.

• Your installation problems are solicited. Write for catalog and technical data. We also have technical and sales representatives in your area for your convenience. All standard items are shipped from stock the same day your order is received. Excellent service on "'Specials".
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It covers typical examples of tension linkage applications . . . helpful step-by-step data on equipment selection and examples to guide you in making your selections. There are tables of dimensional data and other important facts you'll find useful in your work.

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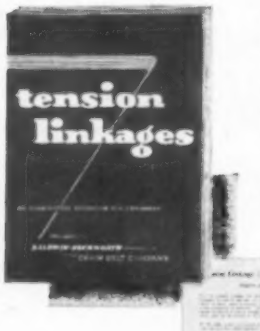


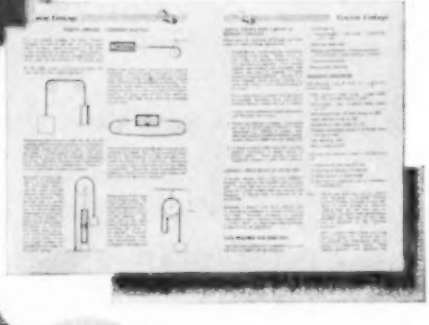

BALDWIN·REX TENSION LINKAGES

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Division of Chain Belt Company
Springfield 2, Mass.

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*Company*.....*Dept*.....

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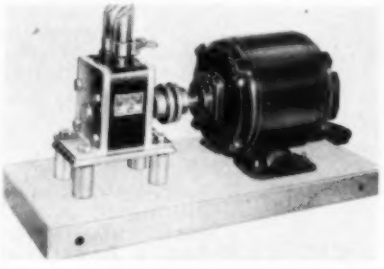
**NON-CORROSIVE PUMP**—A non-corrosive "flex-i-liner" pump in which the transferred liquid or gas never touches any of the metal parts has been developed by the Vanton Pump Corporation. The unique design of the pump makes it particularly suitable for handling corrosive liquids such as acids, alkalies, industrial alcohols, as well as many corrosive gases. The construction of the pump is such that the fluid flows on the outside of the "flex-i-liner" and on the inside of the body block. The "flex-i-liner" material can be specified in either a pure gum rubber or a synthetic depending on the particular application, while the body block can be obtained in plastic or a hard rubber. An eccentric rotor mounted on a ball bearing rides inside and activates the liner. The squeegee action created is the basis of the pump operation. The pump is a positive displacement, self-priming design.



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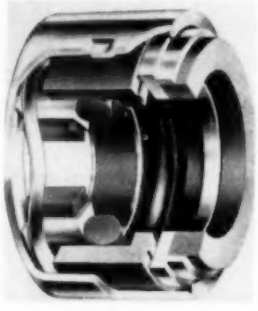
**"ALL-IN-ONE" MECHANICAL SHAFT SEAL**—To meet the shaft sealing needs of pump manufacturers, Sealol Corporation now offers this new line of mechanical seals; the FCB and GCB "Sealol" balanced pressure seals. These are "all-in-one" seals — factory assembled and tested. Their construction eliminates the possibility of lost parts, damaged parts, faulty assembly, or contamination of the precision lapped seal faces. No special machining on the part of the pump manufacturer is required when these seals are used. Rubber friction members, incorporated in the rotating and stationary elements of the seals, provide the proper driving and holding actions. This design permits hand assembly of the seal in the pump. Seals are available for shaft sizes from ⅜ in to 1½ in.



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**MERCURY SAFETY SWITCH**—For positive safety in hazardous, explosive locations Panalarm Products, Inc. has developed a mercury switch with either push button or selector knob. To operate the switch, the knob is turned or the button pushed which inclines the armature thus actuating the mercury switch. There is no possibility of any spark because the actuating linkage is purely mechanical in nature. The switch is designed for vertical panel mounting and is a single pole switch with either double or single throw action. Push button models feature a spring action that returns the switch to the original position when finger pressure is released.

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Circle 21 on Reader Service Card


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+ 10 CONTROL ASSEMBLIES + NUMEROUS VARIATIONS

= Thousands Upon Thousands of VALVAIR AIR CONTROL COMBINATIONS

Three body styles complete a line of 2-way, 3-way, and 4-way open-end exhaust, 3-way piped exhaust and 4-way piped exhaust valves, plus many methods of actuating, plus almost countless variations. Ends of all bodies in respective sizes are identical, permitting incorporation of any desired control assembly; internally, parts are interchangeable. Important features: leak-proof "O-U" packers (no metal seats); standard pipe area through valve permits unrestricted air flow and minimizes pressure loss. For controlling air, water or oil pressures up to 175 p.s.i.; temperatures up to 120° F. Sizes ¼", ⅜", ½", ¾", 1".

*For further information get Bulletin "A".*

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AFFILIATE: SINCLAIR-COLLINS VALVE CO.

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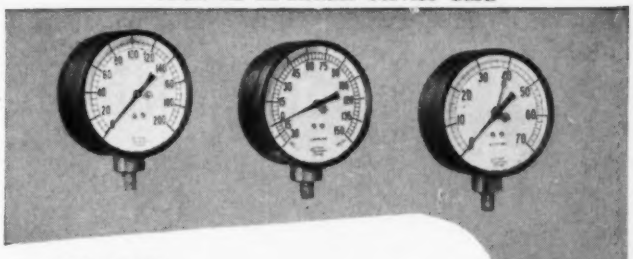

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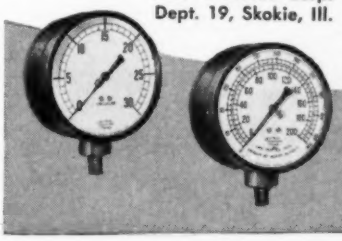

MARSH



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*Savings in oil alone pays cost of installing Honan-Crane Hydraulic Oil Purifiers*

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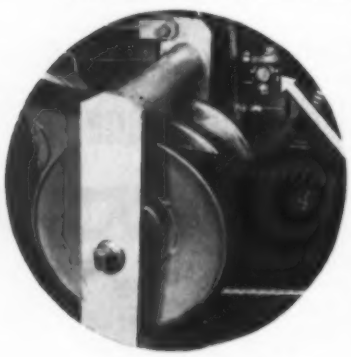
The DoALL Company, Des Plaines, Illinois has developed a most ingenious yet practical machine for contouring and shaping solids quickly and with elimination of chip waste.

Operational safety is provided in part by an ASCO 3-Way Solenoid Valve. It is used in the brake circuit and is open during machine operation allowing the oil to circulate. When the machine is turned off—or if a blade should break—the current to this solenoid valve is cut off which checks the flow of oil through the brake circuit, thus forcing the hydraulic oil into the brake cylinders which actuates the brakes and, in turn, stops the wheels.



So much in the way of automatic control—including remote control—with solenoid valves is being done that you should investigate them fully for controlling the flow of any gas or liquid in the machine you are designing. ASCO Engineers will be glad to recommend the proper type for your problem, as they have for hundreds of others. In writing, be as detailed as possible.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

**Automatic Switch Co.**

385H Lakeside Avenue • Orange, New Jersey

## Beginner's Course

*(Concluded from page 23)*

plates are necessary. A built-in adjustable relief valve reduces outside piping.

In the design of the Roper 300 psi pump, sleeve bearings are used with flanges which form wear plates for the gear faces. Their 1000 psi pump uses roller bearings and bronze wear plates.

The use of outboard bearings is advantageous where the drive shaft is subjected to side thrust or where misalignment is excessive.

Having considered some of the construction details of gear pumps, typical performance characteristics should be noted. The curves in Figure 4 give a relative relationship of gear pump performance. Each pump design has somewhat different service characteristics. The manufacturer's pump performance chart is a guide for selection.

*Chapter VIII, Part 3 will discuss the design and application of internal gear type pumps. Please save each installment for future reference.*

---

## Here's How

*(Concluded from page 19)*

Venting the valve is accomplished by using a solenoid operated, normally closed shut-off valve (2). When the cylinder has completed its work, a limit switch is automatically tripped to energize solenoid E, which opens valve (2), making the vent connection on valve (1) subject to atmospheric pressure. This arrangement for automatic unloading is in wide use, but we feel that the circuit connections of valve (2) through valve (3) to tank are of interest.

It was first felt that shut-off valve (2) could be connected directly to tank without connections at port B of valve (3). We found that this simpler connection would unload the valve, but after the system was in use for a short time, it was impossible to build up pressure when desired. Even with solenoid E deenergized to close valve (2), the pump still unloaded to tank.

What had happened? The shut-off valve (2) had worn slightly so that even in the closed position it vented the sensitive, balanced spool relief valve. The pump kept discharging to tank in both positions of valve (2).

By making vent connections to valve (1) as shown, the unloading system operates properly, because port B and the vent connection are blocked and not open to tank when the cylinder is being raised. Although the vent connection is open to tank on the downward stroke of the cylinder, valve (1) does not vent until solenoid E is energized to open valve (2). The slight leakage does not unbalance the valve once pump pressure has been built up.

L.R.S.

# Midget Bulldozer Does Giant's Work

CLARENCE B. MITCHELL OF PINEWOOD SHORES, Traverse City, Michigan, has found an answer to his grading, excavating, backfilling and other earth moving problems with the "Mighty Mouse" baby bulldozer. This "garden" size machine does many of the jobs that are normally associated with massive and expensive equipment and moves bulk materials at an amazingly low cost per yard.

The machine itself is a small, compact, crawler tread tractor, driven by a 5 hp single cylinder, air cooled, gasoline engine. The combination scoop and dozer (36 in wide x 18 in deep by 16 in high) handles a normal load of 4½ cu ft; the scoop is raised and lowered by the welded lifting yoke which is integral with a triangular frame, the upper angle of which is bolted to the rod of the vertically mounted, double-acting hydraulic cylinder. The 5 gpm gear pump, cross mounted on the steel channel frame of the dozer, is driven from the engine shaft by a V-belt. The 2¼ in bore, 13 in stroke double-acting cylinder has automatic by-pass at top and bottom of stroke.

Control is by spring centered four-way valve. All operating hand controls are beside the seat, under the driver's hands.

The hydraulic circuit is very simple. With the engine running, the pump dumps to tank. When the valve lever is moved, the four-way valve shifts to permit flow to the head end of the cylinder, extending the cylinder rod and raising the yoke and dozer. As the cylinder reaches its fully extended position, oil by-passes but maintains the cylinder in the elevated position for holding or carrying a full load. Since the four-way valve is spring-centered, it is necessary to manually reverse the valve lever to permit oil to flow into the rod end of the cylinder. This lowers the cylinder, yoke and dozer. When the cylinder reaches its fully depressed position, oil will again by-pass automatically.


Circle 25 on Reader Service Card

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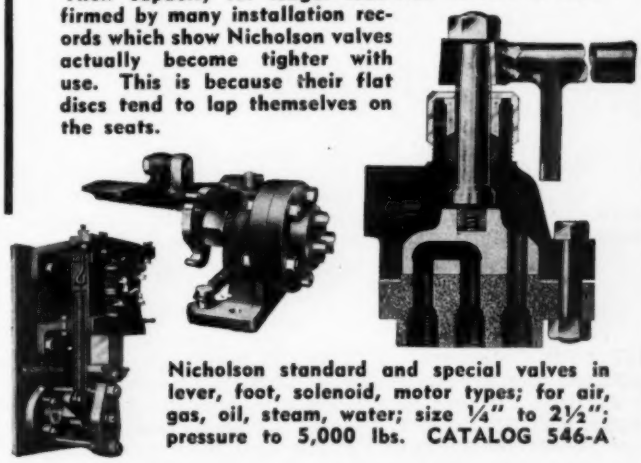
SET RECORDS for LONG LIFE

In a wide range of plants — steel, metal working, processing, etc — Nicholson cylinder control valves have now been in constant use for over 25 years. Their capacity for longer leak-free service is confirmed by many installation records which show Nicholson valves actually become tighter with use. This is because their flat discs tend to lap themselves on the seats.



Nicholson standard and special valves in lever, foot, solenoid, motor types; for air, gas, oil, steam, water; size ¼" to 2½"; pressure to 5,000 lbs. CATALOG 546-A

W. H. NICHOLSON & CO. 213 OREGON ST. WILKES-BARRE, PA.

Sales and Engineering Offices in 53 Principal Cities

# Useful Catalogs and Bulletins

## available for reference

## Power Equipment

**Twin Piston Type Pump . . .** Bulletin 1-P describes a versatile twin piston type hydraulic pump made by the Blackhawk Mfg., Co. Construction of this compact pump, for applications requiring up to 4000 psi, are clearly shown in a two color cutaway. Performance characteristics, charted at 900 rpm, show high actual delivery throughout the pressure range. Rated capacity at 900 rpm is 1.375 gpm. The two pistons are driven by an eccentric drive shaft. Examples of how the pump can be driven on a variety of jobs, are pictured.

Circle 113 on Reader Service Card

**Low Pressure Cylinders . . .** Designed for operation up to 110 psi, seven styles of cylinders in a range of sizes are illustrated in 20 page Catalog 236 issued by Hanna Engineering Works. Construction features include adjustable cushions using "O" ring sealed ball check valves, piston packing expander rings and spring backed rod packing. Dimensional data on each of the styles is provided.

Circle 114 on Reader Service Card

**Hydraulic Drives . . .** Bulletin 101 released by the Rockwell Manufacturing Company, Hydraulic Division includes line drawings of typical installations of their Hydro-Syn governor control system to obtain constant speed, constant torque and constant pressure. The variable speed drive, offered in speed ranges up to 5000 rpm and power ratings exceeding 125 hp, is an interesting arrangement of fluid pumps and motor properly regulated by a control valve.

Circle 115 on Reader Service Card

**Induction Motors . . .** Construction features of Allis-Chalmers large two-pole squirrel cage induction motors are given in a new bulletin released by the company. A cross-section view of a typical normal torque, low starting current motor shows the construction of the stator winding, bearing, ventilation, squirrel cage winding, rotor, stator, and bearing brackets. This is supplemented by additional photographs of motors and motor parts.

Circle 116 on Reader Service Card

**Hydraulic Cylinders . . .** Rotocast hydraulic cylinders designed for pressures up to 1500 psi are described in 27 page Catalog 200, Section 2 recently issued by Logansport Machine Co., Inc. Cross-sectioned drawings show construction details, and dimensional layouts are included for each of the seven mounting styles. Nomographs will assist the user in the determination of piston areas, speeds, pressures and forces. A few typical examples of special cylinders to meet unusual problems are shown.

Circle 117 on Reader Service Card

**Fluid Power Equipment . . .** New 8-page Bulletin 10051-A illustrates and describes the Oilgear Company's complete line of fluid power pumps, motors, transmissions, cylinders and valves. It features a new line of small constant and variable delivery pumps, a new line of axial piston motors; an improved line of standard cylinders for pressures up to 1500 psi and a new line of heavy-duty cylinders for pressures up to 3000 psi. It introduces a standard line of pilot and directional control valves, relief and foot valves, surge valves, combination valves, differential valves and auxiliary fluid equipment for pressures up to 3000 psi.

Circle 118 on Reader Service Card

**Air Powered Devices . . .** The story of precision control applied to air cylinders is graphically told in a new 24 page Bulletin CL-30 issued by The Bellows Co. Seven pages are devoted to application ideas which show how air devices increase production and profits. Air power, accurately controlled by electrically operated valves, is shown at work on standard machine tools, punch presses, special tooling and assembly units. Clearly presented in a large drawing, is the integral construction of the Bellows air motor and built-in Electroaire Valve. Wiring diagrams and dimensional layouts of these air motors are included to assist the designer. The bulletin offers data on such "packaged" air devices as rotary feed tables, drill feeds, vises and bench presses.

Circle 119 on Reader Service Card

**Electric Motors for Industrial Applications . . .** Lima Electric Motor Co. has available Bulletin MB-1 which illustrates their RS, drip-proof, induction motors. Widely used as pump drives on hydraulically powered equipment, RS motors are dynamically balanced to eliminate vibration and provide smooth operation. A cutaway drawing shows the sturdy compact construction.

Circle 120 on Reader Service Card

## Materials and Services

**Precision Casting Process . . .** An 8 page illustrated brochure issued by Alloy Precision Castings Company, is packed with informative engineering data on precision castings produced by the Mercast process. Pictorial story shows the step by step production of stainless steel aircraft parts by precision castings. A graphic description of booking dies and their advantages in precision casting is included. Castings in a wide range of ferrous and nonferrous metals are pictured.

Circle 121 on Reader Service Card

**Spring Buyer's Guide . . .** A new 8 page bulletin, designed to aid economical purchasing by reducing to

understandable terms the various factors affecting the cost of coil springs, has just been published by the Hunter Spring Co. Intended primarily for the use of purchasing agents and spring buyers, the guide will also be valuable to production men, engineers and inspectors.

Illustrated by two charts, 13 photographs and 28 line drawings, the two color bulletin is divided into four sections—Engineering Manufacturing, Materials, and a Glossary of Spring Maker's Terms. The first section covers the influence of engineering and resulting specifications on spring cost. Factors of tolerance, spring ends and space design are each illustrated by diagrams contrasting more economical with less economical designs.

Circle 122 on Reader Service Card

**Casting Recovery Process . . .** An informative question and answer pamphlet describes The Tincher Process for the recovery of casting rejects due to porosity. Castings for air and oil equipment have been successfully salvaged. Method of impregnation, cost, and applications are tersely presented in this type of format.

Circle 123 on Reader Service Card

## System Accessories

**Flexible Couplings . . .** Design of spider and cushion type flexible couplings are detailed in Lovejoy Flexible Coupling Company's catalog. The couplings are classified on the basis of physical shape and amount of power transmitted and the type of cushion material. Complete dimensional data and power transmitting ability are charted. Valuable design tables assist in the selection of couplings for fluctuating load and pulsating power, and for non-pulsating service. Use of these tables is illustrated with a problem involving the selection of a coupling for use between a 2-cylinder gas engine and a 2-cylinder single-acting pump.

Circle 124 on Reader Service Card

**Mechancial Packings . . .** A "Catalog Guide", prepared by the Flexrock Company, Packing Division, features mechanical packings. Compiled in an easy-to-read style, this 32 page book graphically illustrates and describes their line of packings, including the popular Process Packing which is self-forming, self-lubricating and self-sealing. Included is a simplified recommendation chart, which lists the recommended packing material for a type of fluid and service.

Circle 125 on Reader Service Card

**Flexible and Rigid Remote Controls . . .** Arens Controls Inc. offers a 4 page brochure illustrating their cable control links for remote push-pull operating. Construction features of both flexible and rigid units are shown. These controls and fittings find wide use in the remote operation of hydraulic valves.

Circle 126 on Reader Service Card

**Oil Filters . . .** Engineering test data on the operation of Marvel Engineering Company's sump type Synclinal filters is tabulated in 8 page Catalog 104. Cutaway sections show the filtering mechanism which uses a wire mesh having a large filtering area. Installation drawings show reservoir mounted filters used singly or in a multiple manifold arrangement.

Circle 127 on Reader Service Card


Circle 27 on Reader Service Card

BARCO
*High Pressure*
SWIVEL
JOINTS

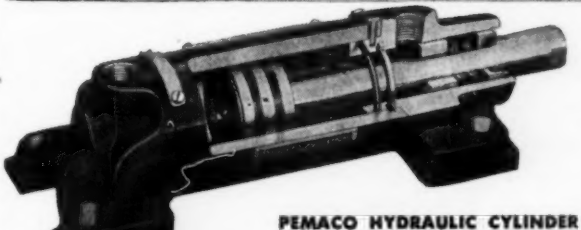
*Flexibility for*
HYDRAULIC PIPING, TUBING!

- **AIRPLANE TYPE** — First developed for use on large planes; now widely applicable to industrial hydraulics.
- **FOR BETTER ENGINEERING!** Put flexibility where you want it—without the nuisance of sagging, flopping non-rigid lines. No expansion under pressure. 360° swivel action, with or without side flexibility. No binding. Functions perfectly at extremely low temperatures.
- **SMALL, LIGHT, COMPACT** — Many styles and sizes, ⅛" up. Pressure ratings to 3,000 p.s.i., or higher under certain conditions.
- **PRESSURE SAFE** — The seal will not break or blow-out suddenly. High temperature and fire resistance.
- **ENGINEERING RECOMMENDATIONS** — Backed by years of experience. Ask for information.

*Nationwide Sales and Service.*

BARCO MANUFACTURING CO.
1832 C Winnemac Ave., Chicago 40, Illinois
*In Canada:* The Holden Co., Ltd.

PEMACO HYDRAULIC AND AIR CYLINDERS
Designed to J.I.C. Hydraulic Standards



PEMACO HYDRAULIC CYLINDER

The reputation enjoyed by PEMACO for building first quality hydraulic and air cylinders was not acquired by chance. Sound engineering, modern design, the finest materials combined with years of experienced craftsmanship, has resulted in recognized acclaim throughout industry

*Check these 11 points of superiority of the PEMACO HYDRAULIC CYLINDER:*

- "Heavy duty" hi-tensile cast iron castings (steel castings optional).
- Ample bronze bearing—oriented behind packing to reduce surge pressure.
- New type, low friction ram seal.
- "Seal guard" ram scraper gives positive packing protection.
- 50 Rockwell — hardened and grounded steel ram — score resistant.
- Automotive type piston rings.
- "O" ring seals.
- Internal snap type keeper ring.
- Piston and ram positively secured by patented lock nut.
- Precision honed steel tubing.
- Designed to J.I.C. Hydraulic Standards.

Write for complete information and engineering data.

PETCH MANUFACTURING COMPANY
2769-71 HARPER ST.
MT. CLEMENS, MICH.

Circle 28 on Reader Service Card

Circle 29 on Reader Service Card

AIR-MITE AIR CYLINDERS

SINGLE ACTING

MICRO

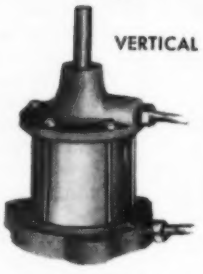
DOUBLE ACTING

CLEVIS

**Worth Their Weight in GOLDen Man-Hours**

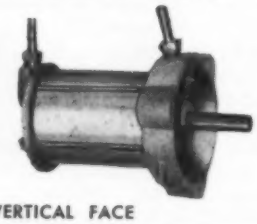
SAVE time, spoilage, cost . . . speed production . . . reduce fatigue . . . on all drilling, reaming, tapping and processing jobs. Available in 1", 1½", 2¼", 3", 4" and 5" diameters; stroke length optional. Single or double action; all mountings.

Write for complete catalog of Air Cylinders and Air Arbor Presses.

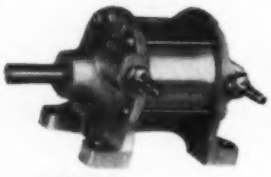


VERTICAL

AIR-MITE 2651-K West Lake Chicago 12, Illinois

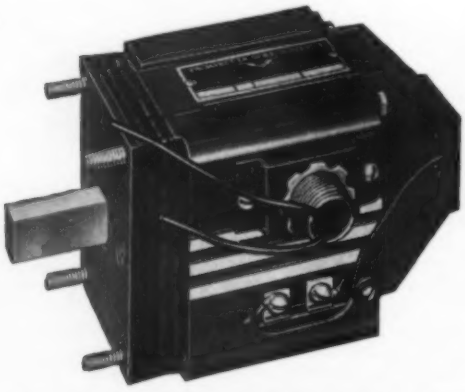


VERTICAL FACE



PARALLEL

**SOLENOIDS FOR HYDRAULIC VALVE**



**G-611-B SOLENOIDS**

- Trombetta G-600 solenoids are specially designed to meet severe operating conditions
- Make your selection from our complete line of standard or special solenoids
- Solenoid brakes of all sizes are also available

**TROMBETTA SOLENOID CORP.**

327 N. Milwaukee Street • Milwaukee 2, Wisconsin

**Oil Purifiers** . . . U. S. Hoffman Machinery Corporation makes available a specification bulletin on their large industrial, I-1118 Series, lubricating oil purifiers. Repackable type cartridges utilize Fuller's earth, cellulose or waste. The operation principle for intermittent or continuous filtering is discussed.

Circle 128 on Reader Service Card

**Air and Oil Packings** . . . Profusely illustrated to show production development and test facilities, this interesting 22 page brochure, issued by Albert Trostel & Sons, Co., describes the manufacturing processes for their complete line of leather and synthetic packings. Each packing style in rubber and leather, for both hydraulic and pneumatic use are described. Line drawings show typical installations for each packing.

Circle 129 on Reader Service Card

**Shock Mounts** . . . Cup and plate type, all metal unit mounts produced by Robinson Aviation Inc., are detailed in Catalog 600. Load deflection curves compare their damping characteristics to those of sponge rubber and coiled spring wire. Design features are pointed out for this all metal construction. Met-L-Flex an all steel resilient material provides uniformity of operation over a wide temperature range.

Circle 130 on Reader Service Card

**Universal Joints** . . . Recently released is the 1951 Curtis Universal Joint Company, Inc. Catalog C1. This catalog supplies data that is a "must" for every person in industry who has to do with purchase, design, production or maintenance of universal joints. Some of the highlights of this catalog are: how to select universal joints, dynamometer tests and assembly and dis-assembly instructions. Accurate graphs include static torque tests, efficiency and frictional heat loss curves.

Circle 131 on Reader Service Card

**Air Valve** . . . An engineering data sheet shows the construction features of the Keller Tool Company's 4-way air valve. Available in ¼, ½ and 1 in sizes, this spool type valve is designed for fast control of double acting cylinders. This design features poppet control which may be applied remotely. Parts for this control system are illustrated.

Circle 132 on Reader Service Card

**Self-Sealing Couplings** . . . Sperry Products, Inc. offers Bulletin 22-106 which illustrates the design and operation of their quick disconnect couplings for pipe and hose lines. Drawings show both on and off positions of the coupling. Wing nut, cam lock and hex nut styles are detailed.

Circle 133 on Reader Service Card

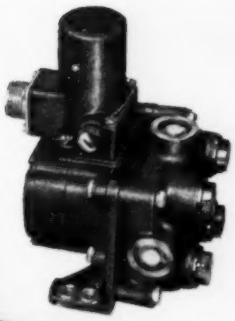
**Vibration Isolation** . . . Here's an informative little booklet titled "Why it Pays to Anchor Your Machines with Unisorb". Actual shop photographs show machines properly mounted to control transmission of vibration and noise. Prepared by The Felters Company, the booklet presents installation data and applications for these vibration isolators.

Circle 134 on Reader Service Card

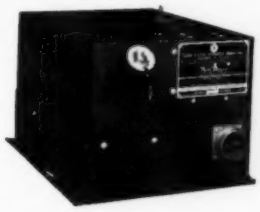
**Packing Standards** . . . Prepared by the Hydraulic Engineering Department of the E. F. Houghton & Co., this 32 page booklet titled "Hydraulic and Pneumatic Packing Standards for Leather and Synthetic Rubber" supplements their older handbooks to show the progress made toward standardization. Tables present dimensional data on their complete line of packings.

Circle 135 on Reader Service Card

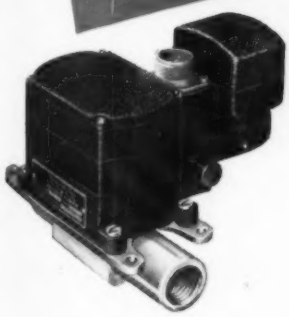
# LOOK TO *Bendix-Pacific* FOR ELECTRO-HYDRAULIC EQUIPMENT



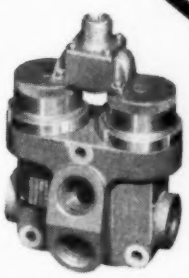
**Bendix-Pacific Geneva-Loc Operated Valves** offer the combined advantages of two proven items—Bendix-Pacific manually operated AN type 4-way Valves and the Bendix-Pacific adjustment-free Geneva-Loc actuator. Over 40,000 valves and 20,000 actuators are now in service.



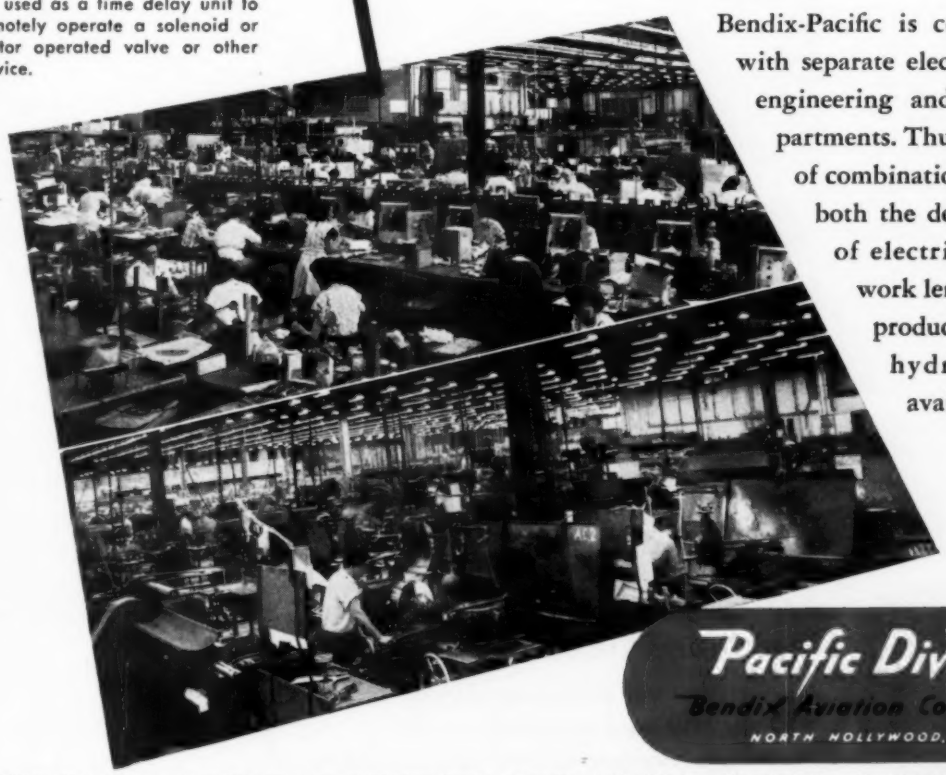
**Bendix-Pacific Power Units**—This Electro-Hydraulic Power Unit is a complete, independent power system located where the work is done. Developed by Pacific Division engineers to meet requirements of large aircraft, the unit offers the power *transmission* and *control* advantages of electricity and the power *application* advantages of hydraulics. First developed for the C-97 airplane cargo door, these systems have been used almost without change or service troubles since the airplane was introduced.



**Time Delay Valves**—These units automatically reset themselves at any time the circuit to the actuator is open and then re-established. The unit is adjustable to provide for any desired time delay between closing of the circuit and shutting off of the valve. Also, the actuator can be used as a time delay unit to remotely operate a solenoid or motor operated valve or other device.



**Solenoid Operated Valves**—Bendix-Pacific makes many types of solenoid operated valves. Shown is the new trail-type solenoid operated hydraulic 4-way valves for applications requiring the cylinder ports to be open to return in the neutral position. The valves operate at speeds up to 5/100 second with low current drain and without electrical holding coils or switches.



Bendix-Pacific is completely equipped with separate electronic and hydraulic engineering and manufacturing departments. Thus, in the manufacture of combination units, specialists in both the design and production of electrical and mechanical work lend their full talents to producing the finest electro-hydraulic equipment available.

Bendix

Pacific Division

Bendix Aviation Corporation

NORTH HOLLYWOOD, CALIF.

East Coast Office: 475 Fifth Ave., New York 17 • Export Division: Bendix International, 72 Fifth Ave., New York 11 • Canadian Distrib.: Aviation Electric, Ltd., Montreal

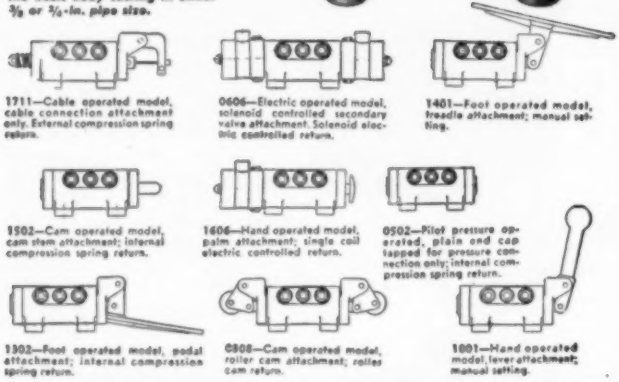
Circle 32 on Reader Service Card

MODERNAIR C V SERIES

# "the Versatile Valve"

FOR AIR, WATER & LOW PRESSURE HYDRAULIC SERVICE

*Twenty different left end attachments are available for use with each of 14 Modernair basic valve models — nine of which are illustrated below. In all, nearly 280 distinct valve combinations may be produced using the basic body casting in either ⅜ or ½-in. pipe size.*



1711—Cable operated model, cable connection attachment only. External compression spring return.

0606—Electric operated model, solenoid controlled secondary valve attachment. Solenoid electric controlled return.

1401—Foot operated model, treadle attachment; manual setting.

1502—Cam operated model, cam stem attachment; internal compression spring return.

1606—Hand operated model, palm attachment; single coil electric controlled return.

0502—Pilot pressure operated, plain end cap tapped for pressure connection only; internal compression spring return.

1302—Foot operated model, pedal attachment; internal compression spring return.

0808—Cam operated model, roller cam attachment; roller cam return.

1801—Hand operated model, lever attachment; manual setting.

*WRITE FOR NEW VALVE FOLDER:*

**Modernair** TRADEMARK **CORPORATION**

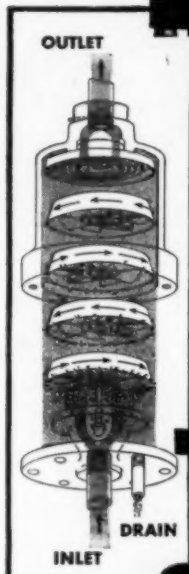
SAN LEANDRO · CALIFORNIA

Circle 33 on Reader Service Card

# Let The ARIDIFIER

## CLEAN YOUR AIR AND GAS LINES

***Removes 92% Oil, Water and Dirt***




**The Aridifier gives you positive removal of oil, moisture and other foreign matter from air or gas lines. With paints and lacquers it often eliminates bloom and imperfections in finish. It provides dry lines for ceramics, sand blasting, for air cleaning, etc. Wherever the need exists for *dry* clean air or gas, the Aridifier delivers the goods. Easily installed. No maintenance problem. 10 models available. Capacity range: As low as 7 CFM to 17,000 CFM.**

***BULLETIN 147 Tells The Complete Story***

**HOW IT WORKS** **Exploded view shows how four multi blade rotors revolve at high speed in opposite directions under impact of air movement through non-aligned rotor spaces. Moisture, dirt and other foreign matter which collect on rotor blades are thrown out of air stream by centrifugal force to side of housing, and pass into drain.**

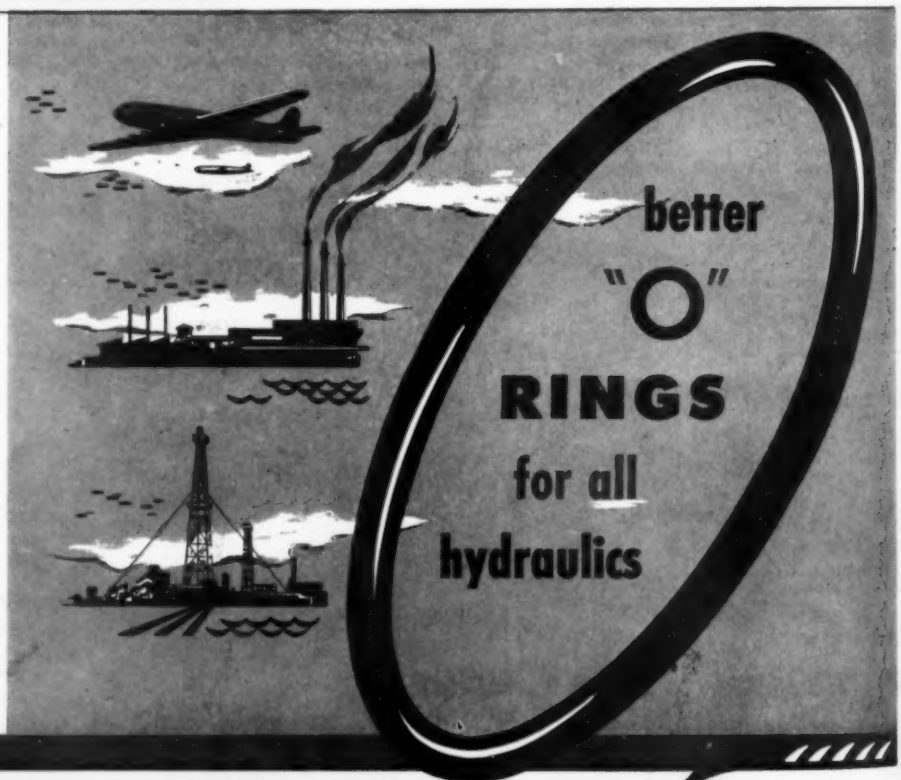
**Made By The Manufacturers of Logan Lathes and Shapers.**

**Logan ENGINEERING CO.**

4920 W. LAWRENCE AVE., CHICAGO 30, ILL.

**"Parco"** is a trade name to rely on for better "O" rings. Better because the material used is precision compounded and fabricated by men with years of experience. All dash numbers of 6227, 6230 and 6290 series for commercial applications or Army-Navy installations to Specifications MIL-P-5516 (6227 and 6230) and MIL-P-5510 (6290) are available from stock. Silastics, Kel-F, and other special compounds are available on order.

*Catalog and engineering data on request. Write us today.*




**Parco**

***Plastic and Rubber Products Company***

**2100 Hyde Park Blvd., Los Angeles 47, Calif.**

**919 No. Michigan Ave., Chicago, Ill.**

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Circle 35 on Reader Service Card

CHOOSE THE AIR VALVE YOU HELPED DESIGN

FOR AIR CYLINDER CONTROL
FULL FLOW • COMPACT • ONE MOVING PART
PRECISION SPOOL AND BORE THAT IS
HARD CHROME PLATED FOR EXTRA LIFE
BALANCED TYPE "AIR PRESSURE SEALED"

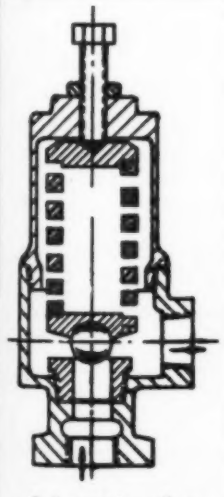
TWO BASIC
PIPE SIZES
3/8" - 3/4"

MAC
MECHANICAL AIR CONTROLS, INC.
5427 HECLA AVENUE
DETROIT 8, MICHIGAN

CAM VALVE | PILOT CONTROLLED VALVE | FOOT VALVE | DOUBLE SOLENOID VALVE | SOLENOID VALVE | TWO PRESSURE VALVE

Write
for
Catalogue

# Know Your Component Symbols



Schematic of a simple relief valve

**RELIEF VALVES**

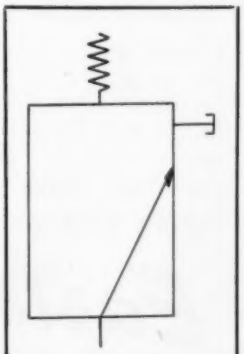
Hydraulic Series

*The second in a series showing the symbol and a typical schematic of the valve it represents.*

**Relief valves** are often referred to as safety valves or maximum pressure valves. They are used to protect the pump from excessive pressure by providing a return path for the oil back to the tank when the valve pressure setting is reached.

The maximum pressure setting is established by spring tension as shown on the schematic drawing of the simple relief valve.

While there are many different constructions of relief valves, this simple schematic illustrates the basic function.



JIC Symbol

***Standards File Sheet***

# PLENTY of POWER

## IN THESE HYDRAULIC PUMPS and FLUID MOTORS

There's plenty of power in Eastern fluid motors and hydraulic pumps. They're tough and compact—ideal where space is at a premium. They're dependable, too. Long life under rugged operating conditions is built-in. An Eastern hydraulic pump or fluid motor in your design is good engineering.

## SERIES 100

.1 to 5 GPM—Drive speeds up to 3450 RPM. Working pressures up to 1000 PSI. Average volumetric efficiency: 90%. Average model weight: 1.65 lbs.

Lightweight construction is obtained through use of aluminum housings and nitralloy gears and shafts. Each unit is factory pre-tested for precision and operating efficiency.

**WRITE FOR FULL DETAILS**

**Eastern**
**INDUSTRIES, INC.**
**298 ELM STREET**
**NEW HAVEN 6, CONNECTICUT**


## LITERATURE AND SERVICES OFFERED IN THIS MONTH'S ADS

AIR-MITE. Air cylinders, both single and double acting, in sizes from 1 to 5 in bore, are presented in an available catalog.

Circle 29 on Reader Service Card

AMERICAN CRUCIBLE PRODUCTS COMPANY. Literature and recommendations to assist you in the selection and design of bronze parts are available.

Circle 25 on Reader Service Card

BALDWIN DUCKWORTH DIVISION OF CHAIN BELT COMPANY. "Tension Linkages" are the subject of an informative engineering handbook, Bulletin 51-10.

Circle 20 on Reader Service Card

COMMERCIAL SHEARING & STAMPING COMPANY. Twelve page, illustrated catalog describing oil operated components for pressures up to 1500 psi can be had.

Circle 17 on Reader Service Card

EASTERN INDUSTRIES, INC. Compact lightweight series 100 pumps for .1 to 5 gpm up to 1000 psi are detailed in available literature.

Circle 36 on Reader Service Card

ELECTROL INC. Application data is available describing their hand pumps and selector valves.

Circle 18 on Reader Service Card

GRATON AND KNIGHT COMPANY. Design and application data for synthetic "O" rings are offered to meet individual requirements.

Circle 8 on Reader Service Card

HANNIFIN CORPORATION. Three bulletins are offered: 57W, 241 and 240. Each includes descriptions of air controlled valves operated by hand or foot.

Circle 46 on Reader Service Card

C. B. HUNT & SON, INC. Data sheet 3402 provides full details on a hydraulic strainer for the protection of components in circuits involving pressures up to 1500 psi.

Circle 42 on Reader Service Card

HYDRAULIC ACCESSORIES CO. Literature describing MONOPAC metallic packing for cylinder applications is offered.

Circle 49 on Reader Service Card

**Submit Your Ideas**

**Tell us "Here's How" you do it at your plant. Sketch or jot down your labor-saver and send it in to the Editor—It may be worth $10.00 Every item published is worth $5.00, the best-of-the-month $10.00.**

LEDEEN MFG., CO. Features, selection, mounting and application of hydraulic cylinders are discussed in Bulletin 500.

Circle 38 on Reader Service Card

LOVEJOY FLEXIBLE COUPLING COMPANY. Selector Charts and catalog present data for the selection of couplings to meet specific applications.

Circle 52 on Reader Service Card

## THE MARKET PLACE

**Classified Advertising**

**Rates: For "Positions Wanted" $4.00 minimum, limit 25 words. For all other classifications $4.50 minimum for 25 words, each additional word 15c; bold face type or all capitals, $7.50 minimum for 25 words, each additional word 20c; limit 50 words. Box addresses count as five words.**

**MICHIGAN DISTRIBUTOR**—desires to contact manufacturers of air and hydraulic production machinery and equipment. If you are looking for sales in Michigan address Box 2151 APPLIED HYDRAULICS.

# HANSEN COUPLINGS GIVE YOU 2 Big Advantages

**1. QUICK CONNECTION AND DISCONNECTION**

**2. INSTANT AUTOMATIC FLOW OR SHUT-OFF**

*WRITE FOR CATALOG*

QUICK-CONNECTIVE COUPLINGS for AIR
ACETYLENE • OIL • GREASES • GASES
VACUUM • STEAM • OXYGEN • HYDRAULIC

*REPRESENTATIVES*

BALTIMORE • BIRMINGHAM • CHICAGO
CLEVELAND • DALLAS • DAYTON • DENVER
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BURGH • ROCHESTER • SAN FRANCISCO
SAVANNAH • SEATTLE • ST. LOUIS
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Export Department: CLEVELAND

With Hansen couplings you save precious minutes every time you connect or disconnect a fluid line carrying gas, liquid or grease.

To connect, you merely push plug into socket—flow starts instantly. To disconnect, pull back sleeve on socket, coupling disconnects. Flow is shut off instantly and automatically.

From a wide range of available sizes and types, you can select a Hansen coupling exactly suitable for your application—each type engineered to meet its specific requirements.

**QUICK CONNECTIVE FLUID LINE COUPLINGS...**

## THE HANSEN MANUFACTURING COMPANY

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Ledeen

CYLINDERS

IMPROVE THE JOB

**Their Uses, Features, Selection, Mounting, and Application**

Discussed in New Bulletin 500

*Write for your copy Today!*

Wherever you have to push or pull, lift or lower, press or squeeze, tilt or turn, open or close.

**Ledeen cylinders are good cylinders!**

Ledeen Mfg. Co.

1610 S. San Pedro St.
Los Angeles 15, Calif.

Circle 38 on Reader Service Card


JAS. P. MARSH CORP. The new MARSH catalog covers many styles and types of gauges to provide versatility in mountings and ranges.

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MECHANICAL AIR CONTROLS, INC. Offers catalog describing compact spool-type air valves for directional control; cam, manual or solenoid operation.

Circle 35 on Reader Service Card

MILLER MOTOR COMPANY. Cylinder bulletins A-105 and H-104 are offered along with booster catalog B-200.

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**Sketch Earns $10**

**Tell us "Here's How" you do it at your plant. Sketch or jot down your labor-saver and send it in to the Editor—It may be worth $10.00 Every item published is worth $5.00, the best-of-the-month $10.00.**

MODERNAIR CORPORATION. A new valve folder presents data on directional valves for air, water and low pressure oil.

Circle 32 on Reader Service Card

W. H. NICHOLSON & CO. A line of valves for air and oil, for pressures to 5000 psi, is described in Catalog 546-A.

Circle 26 on Reader Service Card

RACINE MACHINE AND TOOL CO. Catalog P-10-D presents the complete story on this line of pumps, valves boosters and package units.

Circle 48 on Reader Service Card

STANDARD PRESSED STEEL CO. Bulletin 675 describes positive sealing at both major and minor diameter of threads on pressure plugs.

Circle 40 on Reader Service Card

VALVAIR CORPORATION. Bulletin A supplies information on the many combinations available for control valves to be used with air, water and oil pressures ot 175 psi.

Circle 23 on Reader Service Card

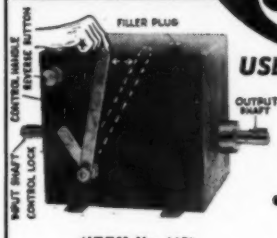
Circle 39 on Reader Service Card


WAR SURPLUS • BRAND NEW

FINGERTIP SPEED CONTROL HYDRAULIC TRANSMISSION

ORIGINAL COST $428.00

NOW ONLY 54.50 F.O.B Chicago




(ITEM No. 115)

USE FOR:

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- CONVEYORS
- MILLING MACHINES
- DRILL PRESSES
- LATHES
- PUMPS
- GENERATORS
- CANNING MACHINES
- GARDEN TRACTORS
- FEED MILLS

Variable output speeds ranging from 0 to input speed now available. Merely move control handle until desired speed is attained. Then turn locking handle to maintain setting. Internal relief valves prevent overloading. Use input power of ¼ to 1½ HP.

This Westinghouse—Oil Gear unit converted to commercial use from 40 MM anti-aircraft traversing mechanisms, consists of a variable displacement hydraulic pump feeding a fixed displacement hydraulic motor. These components are contained in a crackle-finished steel oil reservoir (capacity 2 qts.) Adjustable relief valves set at factory for 100 inch pounds of torque may be reset up to 180 inch pounds.

Independent reverse control allows full output power and speed selection in either direction of rotation. Input rotation is counter-clockwise facing shaft. Recommended input speeds not to exceed 750 RPM. Both input and output shafts measure ⅝" in diameter and include keyway. Overall dimensions 7½"x7½"x11½".

Gov't. acquisition cost $428.00. Shipping weight 26 lbs. Complete with 2 quarts of oil and full instructions.

GROBAN SUPPLY CO., Inc. Dept. AH-3
1507 S. MICHIGAN AVE. CHICAGO 5, ILL.

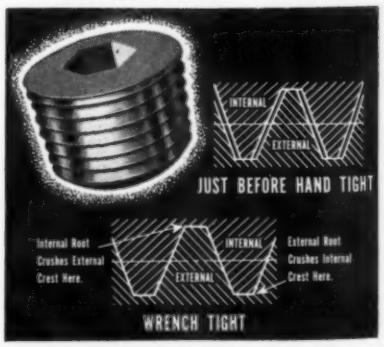


UNBRAKO

DRYSEAL

THREAD

PRESSURE PLUG




SEALS TIGHT WITHOUT COMPOUND

Unique thread design of UNBRAKO "DRYSEAL" Pressure Plugs provides positive sealing at both major and minor diameters of threads, preventing spiral leakage, even under extreme pressures. Full range of sizes from 1/16" to 1¼" N.P.T.F.

Write for Bulletin 675.

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STANDARD PRESSED STEEL CO.

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Tannate LEATHER PACKINGS

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## Made to fit your Specifications

Tannate Leather Packings are tailor made of tough, pliable, oil resistant leather to provide long, dependable service. Available for hydraulic or pneumatic use over a wide range of pressures and temperatures. Friction losses are low. Because of Tannate's pliable and oil resistant properties, they will effectively seal-in lubricants and many chemicals.

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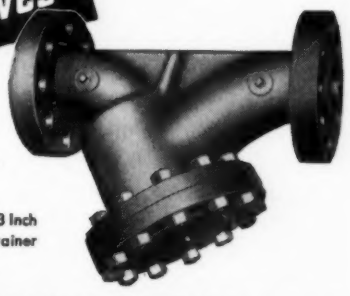
J. E. RHOADS & SONS
35 NORTH SIXTH ST., PHILA. 6, PA.



Quick-As-Wink AIR AND HYDRAULIC Control Valves



No. 16050 3 Inch Hydraulic Strainer

**HIGH PRESSURE HYDRAULIC STRAINER** to 1500 p.s.i.
protects valves, cylinders and spray nozzles

● Repay their cost many times over. Widely used in steel mills and forging shops to prevent partial plugging of spray nozzles, resulting in rejects due to scale streaks. Cast electric furnace steel housing. The strainer consists of machined and grooved bronze rings nested around a heavy slotted multi-ported bronze back-up cylinder. The rings can be loosened and cleaned easily with compressed air, or completely removed and cleaned in solvent. 1½" to 6" sizes. Send for Data Sheet No. 3402. *It gives full details.*

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

**Quick-As-Wink** AIR AND HYDRAULIC **Control Valves**

*Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated*
Mfd. by C. B. HUNT & SON, INC., 1965 E. Pershing St., Salem, Ohio



# AVICA

*Specialists in Flexible Pipes*

SYNTHETIC HOSE • METALLIC HOSE

FOR ALL FLUID SYSTEMS THROUGHOUT A WIDE TEMPERATURE RANGE

● Avica Synthetic Rubber and flexible metal hose with integral angle couplings.

● Avica Swivel Flange couplings for aluminum and stainless steel tubing.

● Avica Fire Resistant support clamps for flexible and rigid pipes and electric cables.

● Avica Special Design assemblies to solve awkward installation problems.

THERE IS AN AVICA HOSE ASSEMBLY FOR EVERY AVIATION APPLICATION.

*SEND US BLUE PRINTS OR SKETCHES AND OUR ENGINEERING DEPARTMENT WILL DESIGN A HOSE ASSEMBLY TO FIT YOUR REQUIREMENT.*

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TRADE MARK




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The CIRCLE SEAL principle
insures
ABSOLUTELY LEAKPROOF performance
unequalled in any CHECK VALVE

Circle Seal Check Valves provide positive, bubble-tight sealing in any mounting position. The resilient "O" Ring cushions the closing shock — seals to eliminate back flow or leakage.

Pressures: 0 to 3000 psi
Temperatures: —65° F to 280° F
Sizes: 1/8" to 1"

CIRCLE SEAL precision check valves

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1247 East Green Street
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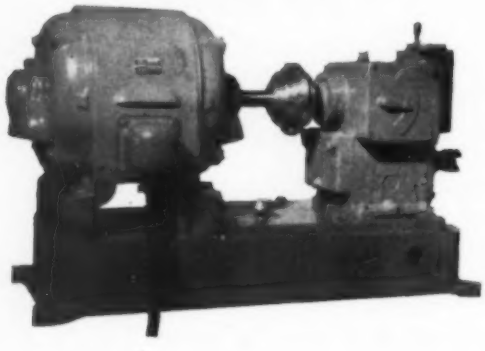
Engineering data sent free of charge on request.



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NEW WEGNER HYDRAULIC TRANSMISSION . . .

• Here is the New Wegner Hydraulic Transmission to supply your variable speed requirements at constant torque.

This simple compact unit consisting of a variable displacement pump directly ported to a constant displacement motor provides a maximum output torque of 63 in-lbs. at all speeds from 0 to 1200 rpm in either direction Maximum horsepower output of 1.2 at 1200 rpm.

Wegner's new transmission is ruggedly built for long, dependable, efficient operation supplying your power needs at minimum cost.

*Write for complete engineering data today.*

WEGNER MACHINERY CORP.
35-41 ELEVENTH STREET • LONG ISLAND CITY 6, N. Y.

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# Bulldozer Hydraulics

*(Continued from page 21)*

of the system due to the surge that precedes the opening of the relief valve and, in addition to the shock loads imposed on the hydraulic pump, other objectionable results are produced.

It has been possible to utilize an overload type of relief valve based upon principles of a flow control valve. This type of valve permits the input horsepower required by the hydraulic unit to be governed by the load being moved hydraulically rather than on the input horsepower required by the unit for maximum pressure operation.

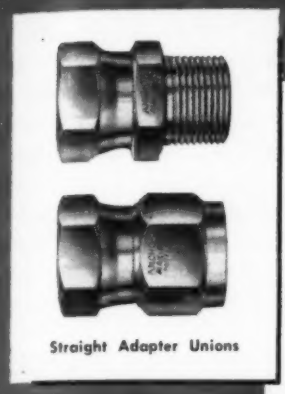
Another requirement that gave considerable trouble before an acceptable solution was found was that for a "float" position valve. This position of the valve results in the formation of a circuit between the opposite sides of the cylinders such that an externally applied force can control blade position without resistance from a blocked hydraulic line. In the case of a bulldozer blade this external force results from the action of the material in the curvature of the blade. The blade is so designed that a full blade of material can be transferred quite some distance with the blade literally floating over the terrain. If a circuit cannot be formed that will permit the blade to float the operator is required to operate the controls constantly so that the blade will not cut too deeply at some spots and at other spots along the way lose its load.

## All Threaded Joints Eliminated

One of the most troublesome and aggravating features of most hydraulic installations on earth-moving equipment has been the impossibility of keeping the systems oil tight. The most persistent source of leaks are those at pipe threaded joints. We have been able to eliminate all threaded joints by utilizing bolted flange joints on welded tubing assemblies and by providing a flanged hose fitting which is re-usable. All pipe and flanges are provided with "O" ring seals.

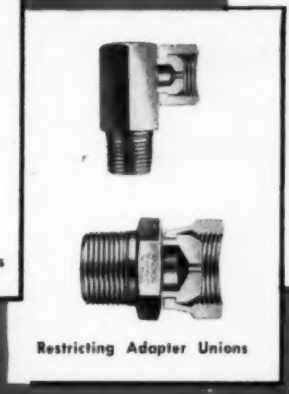
The circuit just described is used for the power units on the bulldozers for our three larger sizes of tractors. The units used for our two smaller sizes are somewhat more simple circuits. The lighter blades for these tractors, the greater ratio of air space in the reservoir to cylinder rod displacement, and the smaller amount of oil displaced during operation permit the use of a restricting orifice in the cylinder return line that satisfactorily produces a condition approximating a counterbalanced circuit even though components of the system are limited to pump, relief valve, and control valve. A comparison of the circuits used for the smaller and larger bulldozers is shown in Figures 1 and 2.

Of interest in all hydraulic installations is the pressure of the system and why that particular pressure was chosen. In our particular case we

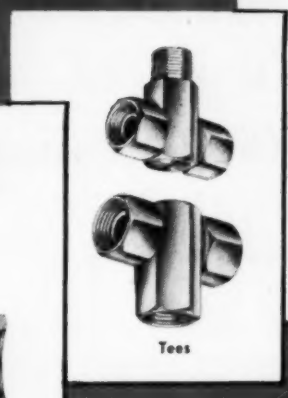


Straight Adapter Unions

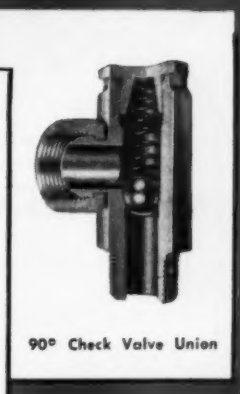
45° and 90° Adapter Unions



Restricting Adapter Unions



Tees



90° Check Valve Union

# ANCHOR Adapter Unions

## —Save You Assembly Time and Money

Anchor Ductile Sleeve Couplings assembled on two wire braid hose for high pressures.

Anchor Sleeveless Couplings assembled on either single wire braid hose or two rayon braid hose for medium or low pressures.

Anchor Clamp-type Couplings are ideal for field service use and emergency repairs. Easy to put on and take off—withstand high pressures.

Use Anchor Assembled Hose Units with the outstanding fittings shown above. You'll have less trouble in the shop on assembly — and less trouble in the field on the job.

Time is money And whenever you save time, you reduce costs.

That's why it pays to use Anchor Adapter Unions and Related Fittings. You see, they're designed especially to speed the attachment of Anchor hydraulic hose assemblies to equipment of all kinds.

In addition to cutting assembly costs, Anchor Adapter Unions and Fittings have these important advantages:

- They provide a leakproof ground-joint connection.
- They are small in size, require little space, and provide a neat appearance.
- You can connect and disconnect them many times without destroying the seal.
- Made from solid steel bar stock and plated to prevent rust, they stand up under the toughest service conditions.
- Their use lets you eliminate one or more pipe-thread joints—gives you a better piping job.
- Assembly in confined spaces is quicker and easier.

The Anchor line of Adapter Unions and Related Fittings is the most complete line available. Save yourself time and money—select those that fill your specific needs.

***Send for complete information on Anchor Adapter Unions and Fittings***

***TEAR OUT THIS COUPON AND MAIL TODAY!***

**ANCHOR COUPLING CO. INC.**
**Dept. AH-21, Libertyville, Illinois**

I like the dependability, the safety, and the time-and-money saving features of Anchor Adapter Unions and Fittings. Please send me a catalog.

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Company Address.....

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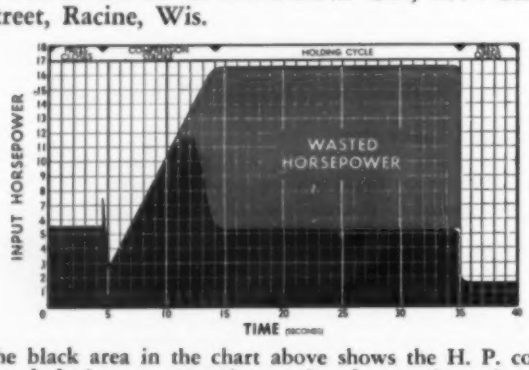
Factory: Libertyville, Illinois • Branch: Detroit, Michigan

# PUT ALL OF THE OIL TO WORK

## Simplify the Circuit and Improve Its Efficiency

Use RACINE Variable Volume Pumps; they automatically deliver only the exact volume required. Relief valves are eliminated. Heating is reduced, horsepower saved. Over-all cost of circuit components is less. These advantages are yours when you "put all of the oil to work."

The RACINE Line is complete. Pumps to 30 G.P.M. Pressure Boosters to 5000 P.S.I. Balanced piston sleeve-type 4-way valves, straight-way valves and controls, all designed for manual electric or hydraulic operation. Complete factory and field engineering service without cost. Write for Free, complete 3-color catalog P-10-D. RACINE TOOL & MACHINE CO., 1774 State Street, Racine, Wis.




The black area in the chart above shows the H. P. consumed during one complete cycle of operation when a No. 6 RACINE Variable Volume Pump and 7:1 Pressure Booster is used. The red area shows the wasted additional H. P. required when an efficient 2-pressure, 2-volume Constant Volume Pump of equivalent size is used. Note the savings in H. P. Chart is based on the operation of a 200-ton molding press with a 10" ram.

**RACINE**

**STANDARD FOR QUALITY AND PRECISION**


have produced units having a relief valve pressure of 950 psi at full pump flow through the relief valve. Recently, on some of our units this pressure has been increased to 1200 psi. Many advantages are present in using the highest possible pressure. All the valves, piping, cylinders, and fittings for the system can be made smaller. In considering the pump, we decided that pumps in the pressure range of 800 to 1200 psi were more economical from a unit cost viewpoint and, especially in the larger sizes, took up much less space. The systems using the higher pressures are also more susceptible to damage from dirt; since our equipment is necessarily used and sometimes repaired under adverse conditions pumps available for 800 to 1200 psi usage are felt to be better suited for our applications. Of course, valves must be fitted closer and machined more nearly perfect for the higher pressures.

Another advantage of higher pressures is that even though the sizes of the conduit in the fluid lines can be much smaller than those used in the lower pressure systems it is possible to reduce flow losses in these lines and thus improve the overall efficiency of the hydraulic installation.

### Structural Requirements for Cylinder

One other circumstance influences the selection of a working pressure for hydraulic systems. In most cases some relationship is desirable between speed of cylinder rod extending and retracting movement. A double acting system is required for bulldozer operation to gain maximum advantages from the use of hydraulic power. This immediately results in a difference in extending and retracting speeds of the cylinder rod. As applied to a bulldozer the hydraulic cylinder is a structural member as well as the power applying device. The structural requirements dictate the size of the cylinder rod and in our application, this and the power requirements determine the cylinder diameter. The lower the pressure used the larger the cylinder becomes and the nearer the extending and contracting speeds of the cylinder come to being the same. Thus the higher the pressure used in the system the greater the difference in these speeds becomes.

The vane type pump has proven to have good service life for our usage. It has little loss in either flow or volume for many hours of service. For this reason and for the fact that it requires less space than some other types of pumps, it was selected for use in our power units.

The bulldozer hydraulic system is readily adaptable to many applications throughout the earthmoving equipment industry. We see a multitude of uses of this type of power and looking toward the future one can see an everwidening field of conquest for hydraulics in applications for work and for controls on other types of units.

*This article was adapted from a paper presented by Mr. Coker at the 1949 National Conference on Industrial Hydraulics.*

## Coming Meetings and Events

**February 18-22**

**American Institute of Mining and Metallurgical Engineers.** Annual meeting to be held at the Jefferson Hotel, St. Louis, Mo.

**February 28 - March 2**

**Society of the Plastic Industry.** Sixth annual technical session of the Reinforced Plastics Division to be held at the Edgewater Beach Hotel, Chicago, Ill.

**March 15-17**

**American Society of Tool Engineers.** Annual meeting to be held at the Hotel New Yorker, New York, N. Y.

**March 19-23**

**American Society of Metals.** Western metal congress and exposition to be held in the Civic Auditorium, Oakland, Calif.

**April 2-5**

**American Society of Mechanical Engineers.** Spring meeting to be held at Hotel Atlanta-Biltmore, Atlanta, Ga.

**April 16**

**Packaging Machinery Manufacturers Institute.** Semi-annual meeting to be held at the Hotel Dennis, Atlantic City, N. J.

**April 16-18**

**American Society of Lubrication Engineers.** National convention to be held at the Bellevue-Stratford Hotel, Philadelphia, Pa.

## Purifiers for Synthetics

(Concluded from page 34)

sarily have to be discarded. Projected hydraulic fluid replacement costs amounted to several thousand dollars per year.

**Oil dollars saved**

This problem was solved by establishing a centrally located reclaiming station in which the contaminated hydraulic fluid was collected, periodically reconditioned and restored to service in the machine.

The reclaiming process comprises passing the fluid through a "homemade" waste-type filter to a centrifuge and then to an earth-type purifier. The waste-type filter effects partial removal of the larger contaminants, such as, scale and metal particles. while the centrifuge removes the bulk of the moisture and some of the mineral oil contaminant. Final reconditioning is effected by the purifier with removal of the colloidal graphite and other materials not removed by the prefilters. The resultant fluid after residual mineral oil is removed by skimming, and with the exception of a slight discoloration acquired over long periods of service, is restored to its original characteristics. Use of the reconditioned tricresyl-phosphate has resulted in savings running to several thousand dollars per year.

Circle 46 on Reader Service Card

HANNIFIN
AIR CONTROL
Valves

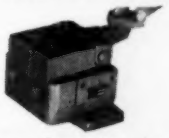
NEWEST TYPES! EXCLUSIVE DESIGNS for EVERY PURPOSE!

THE Hannifin line of Air Control Valves is complete—sizes and types for every purpose! Hannifin leads with newest, exclusive designs for fast, effortless control of air cylinders, presses, and other air operated equipment. Ask for recommendations.

"PACKLESS" HAND OPERATED

Simple, smooth-acting, positive 3-way or 4-way valves. "Packless" rotary disc type. Self-lapping. Sizes from ⅛" to 1¼". *Ask for Bulletin 57W.*

"EFFORTLESS" HAND OPERATED

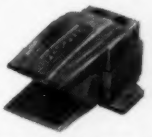


Fast, new, finger-tip, pilot operated sliding disc valve. Effortless; air pressure does the work! For single or double acting cylinders. *Ask for Bulletin 241.*

"PACKLESS" FOOT OPERATED

Treadle type; leaves operator's hands free for other work. Tight-sealing, self-lapping, rotating bronze disc. Sizes ¼" up to ¾". *Ask for Bulletin 57W.*

"EFFORTLESS" FOOT OPERATED



Fast, new, pilot operated, disc type valve. Light, effortless action. Rugged construction. With or without pedal guard. *Ask for Bulletin 240.*

HANNIFIN CORPORATION

1155 South Kilbourn Avenue — Chicago 24, Illinois

Roylyn COUPLINGS *

IMPORTANT FEATURES

- LIGHT WEIGHT
- QUICK CONNECTING
- POSITIVE LOCKING
- HIGH PRESSURE SEAL
- VIBRATION PROOF
- WIDE TEMPERATURE RANGE
- SIZES FROM ¼ INCH TO 6 INCH

* FOR MANY VARIED INDUSTRIAL USES:

- Railroad Diesel fuel lines
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OPEN COUPLINGS

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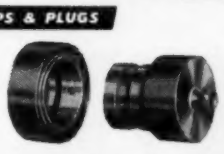

*Features like these mean* CONNECT WITH ROYLYN!

★ *SIZE RANGE*... ¼ inch to 2½ inches. Up to 6 inches in some styles.

★ *PRESSURE RANGE*... 6600 to 650 P.S.I.

★ *MATERIALS*... Aluminum alloy, brass, carbon steel, alloy steel and stainless steel.

★ *OPERATION*... A simple "twist of the wrist"—NO TOOLS REQUIRED!

★ *POSITIVE LOCK*... Locks with a "snap" and positively will not uncouple with vibration, pressure or rotation of the connected hose.

★ *SAFETY*... Laboratory tests for extremes of heat, cold, vibration and years of hard service have proven its rugged reliability.

★ *VERSATILITY*... Open nipple can be used with self-sealing coupling to provide shut-off on one side only. Also open coupling can be used with self-sealing nipple to provide check valve action.

There is a Roylyn Coupling available for practically any type of flexible connection for air, water, hydraulic and chemical applications. Write today for free illustrated catalog and nearest dealer. Inquiries regarding available dealerships are invited.

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714 W. WILSON AVE., GLENDALE 3, CALIF.

*Roylyn makes Good Connections for You!*

## Main - Ten - Ends

### REDUCE PRODUCTION COSTS

End 8. **Set up a planned program of systematic preventive maintenance for your hydraulic equipment.**

Don't expect equipment to operate without maintenance.

While hydraulic equipment requires less maintenance than other methods of power transmission and control, it does require some care to provide this advantage.

The cost of preventive maintenance is less than the cost of breakdowns which result without it.

Preventive maintenance will not eliminate breakdown, it will minimize them.

Make regular visual checks for leaks, oil level and the condition of the oil.

Watch trouble symptoms like noise, high temperature, increased cycle time.

Calculate the life of solenoids and bearings.

End 9. **On actual repairs, analyze and isolate hydraulic trouble before dismantling any part of the hydraulic circuit.**

The maintenance man should have a circuit diagram and be familiar with it. The trouble should be analyzed with respect to the circuit in an effort to isolate its cause.

It is usually a mistake to machine parts which seem to bind or stick. The fits, the limits, the material analysis, the heat treatment and the finish of parts are important for correct operation.

### HENRY FORD MEMORIAL AWARD

The Society of Automotive Engineers, Detroit Section, have established the Henry Ford Memorial Award for the encouragement of younger engineers.

Any SAE member under 33 years of age is eligible to compete by submitting an original paper which has been presented to, or is suitable for presentation to an SAE meeting. Content of competing papers is limited to subjects related to automotive ground vehicles and must describe engineering work or investigation with which the author has been directly associated. The award consists of a suitable certificate of merit and a cash prize of $200.

Members desiring to compete may obtain a prepared brochure through their local SAE Section or by writing directly to the Detroit Section, 100 Farnsworth, Detroit 2, Mich.


MONOPAK
METALLIC PACKING

*Prolongs the Life of Hydraulic Cylinders*

Seals against Oil, Water, Brine, Air, Gases and Refrigerants

ASSURES UNEXCELLED DURABILITY

**Burst-proof, does not blow out . . . Compact and easy to install . . . Low Friction insures long life. Now adopted by hundreds of manufacturers and users of machine tools.**

***Write for Literature***

HYDRAULIC ACCESSORIES CO.
439 E. Fort St. • Detroit 26, Mich.

*'Shear-Seal' Valves*

The 'Shear-Seal' Principle is an exclusive Barksdale development for control of extreme pressures. Fluid flow is always through the center of the 'Shear-Seal'—NEVER between sealing surfaces as in conventional valve principles. Optically flat sealing surfaces of 'Shear-Seals' and porting disc (rotor) are protected by perfect contact at all times. Erosion or 'wire drawing' are not experienced even with extremely dirty high velocity fluids. The higher the pressure, the tighter the seal.

Exceptionally easy operation of Barksdale valves, regardless of pressure, is due to a balanced hydraulic load on the 'Shear-Seals' further relieved by large ball thrust bearings.

Self-alignment and wear compensation of 'Shear-Seals' plus their self cleaning and polishing action against the rotor actually improve the valve with use.

Write for the new Manual Valve Catalog 1B-1, which covers 4-Way Selector, Shut-Off, Dual Pressure Selector, and other Barksdale valves for pressures ranging from 0 to 6000 psi.

BARKSDALE VALVES
1566 EAST SLAUSON AVENUE • LOS ANGELES 11 • CALIFORNIA

*(Continued from page 10)*

We are attempting to work up a so-called kit, to include hydraulic pumps, valves, rams and kindred items which are used extensively by the agricultural trade to provide the user or farmer with hydraulic power on farm tractors; items to have suitable brackets for mounting on the various types of tractors. We have tried several sources without success.

O. L. H.

*We asked for a rain check on answering this until after the last National Conference on Industrial Hydraulics, where the editor made a number of inquiries to several manufacturers of agricultural equipment as well as suppliers of this type of hydraulic equipment. The gist of answers, as we have written you, seems to be that such a kit is something of a problem because of the wide range of mounting brackets that would be necessary and the wide range of power requirements of various types of agricultural machinery.*

---

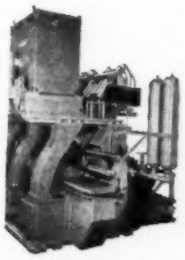
We are manufacturers of passenger and freight elevators, a number of which are of the hydraulic type. General pressure pumps are used for oil circulation and they are quite noisy. It is our understanding that there is a muffler which can be inserted in the pump outlet line to do away with the noise and keep it from entering the hoistway. We would like to know the name and address of the manufacturer; we would appreciate, if possible, for you to send this information to us. Also, if you have any data and details of how a muffler of this type, for eliminating noise from the flow of oil, would be built, we would appreciate the information. The pressure varies from 100 to 225 psi and the size of the discharge pipe from 1¼ to 3 in diameter.

H. J. B.

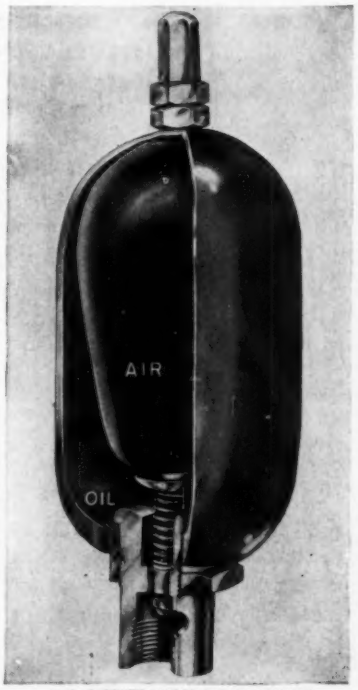
*We do not know of a muffler that, when placed on the pump outlet line, would eliminate pump noise. We would like to call your attention, however, to the article, "Reduction of Hydraulic Noise and Vibration" by G. W. Louthan, mechanical research group engineer, Lockheed Aircraft Corporation, which ran in two installments in the January and February, 1950, issues of APPLIED HYDRAULICS. Mr. Louthan's article is a condensed report of an extensive research program conducted at Lockheed from 1944 to 1948 under the direction of A. M. Kellam. Work on this problem has also been done at Armour Research Foundation, Chicago, by O. E. Teichmann, former secretary of the National Conference on Industrial Hydraulics.*


# How to make Small Motors do the Work of Big Ones

***Greer Hydro-Pneumatic Accumulators store tremendous power in small space . . . deliver it instantly when needed!***



For example, an hydraulic press, which required a 50-horsepower motor, now operates faster, better, more economically with a 1.5-horsepower motor and a pair of Greer Accumulators. Similar motor-size reductions and improved hydraulic performance are achieved with Greer Accumulators in machine tools, automatic welders, packaging machines, and many other production tools.




U. S. PATENTS UNDER OLEAR LICENSES

The Greer Hydro-Pneumatic Accumulator, with its unmatched ability to store energy efficiently, has countless other applications. Today, Greer Accumulators open hatch covers of freighters in 55 seconds; turn diesel starters; cushion the rotors of rock crushers; dampen pulsations of mud pumps; maintain oil volume in high-voltage cables, just to mention a few.

In most phases of industry, application of Greer Hydro-Pneumatic Accumulators to hydraulic equipment usually means better performance, higher efficiency, greater economy. Greer Engineering offers its "know-how" and facilities to help solve your tough hydraulic problems. Write or call us today.

## FACTS TO KNOW ABOUT GREER HYDRO-PNEUMATIC ACCUMULATORS

**Principle of Operation.** A Greer Accumulator is essentially a fluid pressure chamber operating on the principle of Boyle's law. In the accumulator, the potential energy of an incompressible fluid (system oil) is stored under pressure against a dynamic force (air or nitrogen enclosed in a flexible rubber bag) to perform useful work when required by the hydraulic circuit.

**8 Standard Sizes at Low Cost.** Greer Accumulators are available in capacities from 2 cubic inches to 10 gallons, operate at temperatures from —40° to +180° F., at working pressures up to 5,000 psi. Accumulators can be manifolded to give greater capacities, or Greer can design and build to specifications.

**Safe, Durable Construction.** The complete assembly consists of a seamless steel alloy shell; a flexible rubber separator bag with integrally molded high-pressure air valve; and a large oil port assembly for unrestricted flow. Simple to install, easy to maintain. Greer builds accumulators to the highest standards of safety, dependability and efficiency. Safety factor is above 5 to 1.

**Many Diversified Uses.** Greer Accumulators are used for: economical auxiliary power; compensator for leakage and volume; efficient fluid dispenser; power source for secondary circuits; simple emergency power; pressure transfer barrier; reduction of pump pulsations; suppression of line shocks, etc.

**FREE!** *Special bulletin illustrating the many diversified uses of the Greer Accumulator with complete, detailed engineering data and typical hydraulic circuits are yours for the asking. Write for Bulletin 300-A on your company letterhead today. There's no obligation of course.*

**SALES AGENTS IN PRINCIPAL CITIES**

YOUR SYMBOL OF SERVICE

**GREER HYDRAULICS INC.**

454 Eighteenth Street, Brooklyn 15, New York




Circle 51 on Reader Service Card

# POST SCRIPTS OF INDUSTRY

## NEWS · VIEWS · TRENDS

**F. T. Harrington,** vice president for sales for **Vickers Incorporated, Division of the Sperry Corporation** recently announced the appointment of **R. H. Esch** as General Sales Manager. Prior to this, Esch was Industrial Products Sales Manager since 1946 and has been with Vickers for a total of 17 years.

R. H. Esch

Other new appointments at Vickers include **E. O. Clark** to the post of Industrial Products Sales Manager. **J. C. Carpenter** succeeds Clark as the Worcester, Mass. District Manager.

**M. J. Taup,** formerly district manager of Vickers Chicago office, has been appointed Mobile Products Sales Manager with offices in Detroit. **A. M. Lane** and **M. T. Gray** are assuming Taup's former duties in the Chicago District.

**Karl A. Panitz** has been named chief engineer for **National Motor Bearing Co., Inc.** and its subsidiaries **Arrowhead Rubber Company** and **National Seal Co.**

C. S. Kepler, president of **Kepler Engineering Co.,** 451 W. Market, Akron, announces the appointment of **C. J. Dudley,** 3091 Mayfield, as their Cleveland representative. The company maintains an office in Dayton at 1125 Arbor Ave.

**John A. Moreland Jr.,** formerly with Wadell Equipment Co., has been appointed manager of the automotive sales division of **Hunt-Spiller Manufacturing Corp.,** Boston.

**The Wellman Engineering Company** of Cleveland, has purchased the property and business of the **Anker-Holth Manufacturing Company** of Port Huron, Michigan, it was announced by A. E. Gibson, president of Wellman. Anker-Holth will now become the

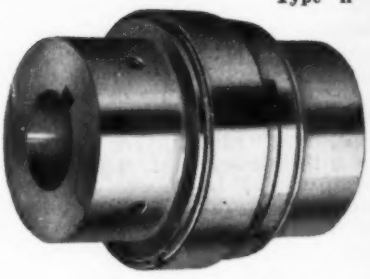

"No chain is stronger than its weakest link"

THE STRONGEST LINK BETWEEN MOTOR AND MACHINE IS A

LOVEJOY LR FLEXIBLE COUPLING

To be sure that the "links" between your motors and machines are strong . . . be sure they are Lovejoy Flexible Couplings. These couplings feature free-floating load cushions suspended between strong metal jaws which take up all wear and punishment. They instantly correct for misalignment, vibration, backlash and surge. Cushions available for every duty from 1/6 to 2500 H.P. and NO SHUT-DOWNS FOR CHANGING. No lubrication ever needed.

Type "H"



*Write for Catalog*
It contains useful information about couplings and Quick-finding Selector Charts.

LOVEJOY FLEXIBLE COUPLING CO.
*Manufacturers of Lovejoy Variable Speed Transmissions*
5037 W. LAKE ST. · CHICAGO 44, ILLINOIS

**Also manufacturers of Lovejoy Universal Joints**




Circle 52 on Reader Service Card

**Anker-Holth Division of The Wellman Engineering Company** with headquarters in Port Huron.

**Hose Accessories Company** of Philadelphia announces the appointment of **Arthur W. Gadd,** 1805 Grand Avenue, Kansas City, Missouri, as manufacturer's representative in the states of Missouri, Kansas, Southern Illinois, Western Iowa and Nebraska. **Almon O. Snyder,** 8001 Carnegie Avenue, Cleveland, will represent them in Ohio, Pennsylvania, West Virginia, Kentucky and Southern Indiana.

**Modernair Corporation** has moved its plant facilities and offices to 400 Preda Street, San Leandro, California.

O. A. Bossart

The appointment of **Otto A. Bossart** as Sales and Engineering representative for the Contract Products Division of the **Young Radiator Company** has been announced by John J. Hilt, vice president. Bossart is a graduate of the University of Wisconsin with a degree in Mechanical Engineering.

Bruce H. Atwater, vice president, Eastern Division of **Pacific Airmotive Corporation,** Linden, New Jersey, announced that **William J. Power** has been appointed Manager of Material Control and Purchasing.

**J. J. Thompson** has been named manager of the Sales Personnel and Training Division of **Worthington Pump and Machinery Corporation** at Harrison, N. J., according to an announcement by W. H. Feldmann, vice president in charge of sales.

**Roots-Connersville Blower Corp.,** Connersville, Ind., has appointed the **Koerner Engineering & Supply Co.** of Portland, Oregon, as exclusive sales agents for all R-C products in the states of Oregon and Washington.

**C. Carlisle Tippit,** manager of the Order and Planning Department of **The Reliance Electric & Engineering Company** since January, 1948, has been appointed General Purchasing Agent of the firm. **Walter H. Behnke,** in Reliance's applied engineering department since 1945, has been selected to take over Tippit's former duties.

The appointment of **Arthur E. Raabe** as general manager of the **Eclipse-Pioneer Division of Bendix Aviation Corporation,** Teterboro, N. J., is announced by Malcom P. Ferguson, president of the corporation.

**T. M. Curtis** has been appointed sales manager of the Southern Division of **Cook Electric Company, Chicago.** His offices are located at 6617 Snider Plaza, Dallas, Texas.

*No costly mechanisms needed!*

Lindberg Double Acting Air Cylinders are proving their adaptability and worth in a wide variety of industrial uses. These simple, dependable, efficient and versatile cylinders are effecting considerable savings throughout industry by the reduction or complete elimination of costly mechanisms involving cams, gear drives and complicated set-ups.

Don't forget—with slight modifications, any size or model of Lindberg Air Cylinder may be used for low pressure hydraulic applications.

WRITE FOR NEW BULLETIN 731—this 16 page catalog just off the press gives details of all standard Lindberg Air Cylinder models and sizes with complete tables on bores, pressures, weights, mountings and conversion to low pressure hydraulics.

Remember—BULLETIN 731 for COMPLETE DETAILS ON AIR CYLINDERS

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**AIR & HYDRAULIC CYLINDERS**

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2441 West Hubbard Street Chicago 12, Illinois

**Specify Lindberg**
when you need HYDRAULIC CYLINDERS
OIL HYDRAULIC PUMPING UNITS
MILL TYPE CYLINDERS • CENTRIFUGAL
BLOWERS • AIR VALVES




Circle 53 on Reader Service Card

offices are located at 6617 Snider Plaza, Dallas, Texas.

**Precision Piston Rings of Indianapolis announce** the operation of their new plant for manufacturing Un-Breakable Alloy Steel, Alloy Bronze and Stainless Steel piston and sealing rings.

Sixteen chapters of the **American Material Handling Society** will participate directly in the program planned for the Materials Handling Conference which will be held concurrently with the National Materials Handling Exposition at the International Amphitheatre, Chicago, April 30 to May 4.

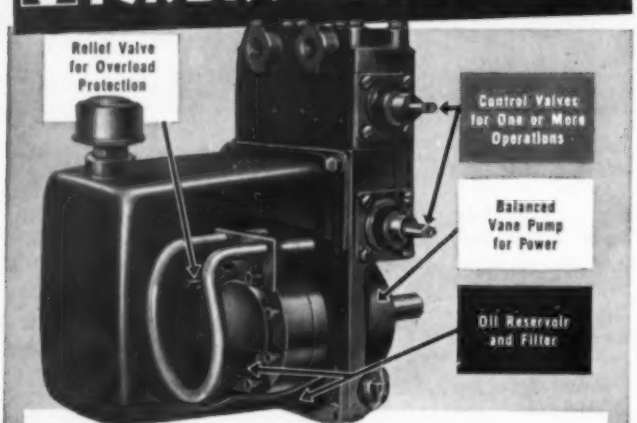
**Harry L. Emerson** has been appointed vice-president in charge of manufacturing of the **Rockford Clutch Division** of the **Borg-Warner Corp.**

# ADVERTISERS INDEX


Adel Precision Products Corp.—10
Aeroquip Corporation—Cover 1
Air-Mite—48
American Crucible Products Co., The—45
American Engineering Co.—9
Anchor Coupling Co., Inc.—57
Automatic Switch Co.—44
Avica Corporation—55
Baldwin-Duckworth Div. of Chain Belt Co.—42
Barco Mfg. Co.—47
Barksdale Valves—60
Bendix Aviation Corp. Pacific Division—49
Brown & Sharpe Mfg. Co.—12
Commercial Shearing & Stamping Co., The—31
Eastern Industries, Inc.—52
Electrol, Inc.—35
Graton & Knight Co. and International Packings, Affiliate—8
Groban Supply Co., Inc.—54
Greer Hydraulics, Inc.—61
Hannifin Corporation—11, 59
Hansen Mfg. Co.—2
Honan-Crane Corporation—43
C. B. Hunt & Co.—55
Hydraulic Accessories Co.—60
James-Pond-Clark—56
Ledeen Mfg. Co.—54
Lindberg Engineering Co.—63
Linear, Inc.—15
Logan Engineering Co.—50
Lovejoy Flexible Coupling Co.—62
L & L Mfg. Co.—41
Jas. P. Marsh Co.—43
Marvel Engineering Co.—14
Mechanical Air Controls, Inc.—51
Miller Motor Co.—4, 5
Modernair Corporation—50
Monsanto Chemical Co.—13
W. H. Nicholson & Co.—45
Palley Supply Co.—64
Pesco Products Div., Borg-Warner Corp.—Cover 2, 39
Petch Manufacturing Co.—47
Plastic & Rubber Products Co.—50
Precision Rubber Products Corporation—7
Racine Tool & Machine Co.—58
J. E. Rhoads & Sons—55
Ross Operating Valve Co.—1
Roylyn, Inc.—59
Standard Pressed Steel Co.—54
Sundstrand Machine Tool Co., Hydraulic Division—6
Texas Company, The—16
Albert Trostel & Sons Co.—3
Trombetta Solenoid Co.—48
Valvair Corporation—43
Vickers Incorporated—64
Wegner Machinery Corp.—56



Hydraulic
VICKERS POWER PACK


Relief Valve for Overload Protection
Control Valves for One or More Operations
Balanced Vane Pump for Power
Oil Reservoir and Filter

The Power Pack offers designers and manufacturers a proven and dependable source of hydraulic power in a single compact "package". Hydraulic balance, automatically controlled operating clearances, and built-in overload protection are among the many advantages that make the Vickers Power Pack an outstanding hydraulic equipment value. Saves labor and reduces cost on agricultural implements, construction machinery, materials handling equipment, and industrial machinery.

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SAVE UP TO 85% in WAR SURPLUS HYDRAULICS

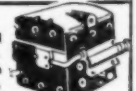
SPECIAL BARGAIN
#29 HYDRAULIC CYLINDER

Gives 20,000 lbs. thrust (push pull) using 1500 PSI line pressure as obtained from our hyd. pumps. Or will produce 40,000 lbs. thrust with 3,000 lbs. line pressure. CAN ALSO BE OPERATED ON LOW PRESSURE AIR SYSTEMS. 4" Bore, 1½" dia. piston shaft, 18" stroke, length 30½". Equipped with ball bearing loaded clevis type mounting and swivel type high pressure steel pipe bracket for easy use. Ideal for road farm and shop machinery, presses, etc. Cost Government $390.00 . . . . . NOW 22.50

HYDRAULIC CYLINDERS

NO. 3A – Bore 1½", Shaft ½" Stroke 5", Length 10½" . . . . 5.75
NO. 9E – Bore 1-3/8", Shaft 1" Stroke 15-5/8", Length 15⅝" . . . 8.50
NO. 35 – Bore 1½", Shaft 1" Stroke 26", Length 23½" . . . . . 12.75

HYDRAULIC TRANSMISSION



Self contained, 2 H.P. constant torque at all speeds with variable volume reversible, piston pump (controlled by outside lever.) supplying piston hydraulic motor. Automatic pressure, Dash pot for smooth control. Power output R.P.M. – 0 to 1/3 input R.P.M. in both directions. Input R.P.M. 1800 continuous 4000 intermittent. Dash pot can be removed for greater R.P.M. Ideal for Lathes, Duplicator Setup on Mills, Conveyors, Small Cars, Drives, Gearing, etc. Includes 2 - 4" Spline Shafts for input and power take-off. Cost Government approx. $400.00 27.50

HAND PUMP

Provides an instantaneous source of tremendous power for almost any heavy work. Double action stroke. Delivers .30 cu.in. per cycle at 3000 PSI. Maximum pressure 5000 PSI. Has built-in reservoir with 2¼ qts. capacity. 3/8" pipe outlets and pressure release valve. Base is 7⅞" diameter. Pump is 23 3/16" overall height. Weight 15.2 lbs. A $40.00 Value 15.95
Used-In good Condition . . . . . 11.95

HYDRAULIC PUMPS

ANGLE PUMP
Positive displacement type, angle piston. Displaces .507 cu.in. per revolution. Has capacity of 6 gal. per minute at 3000 RPM at 1500 PSI continuous 1875 for 15 seconds. Operating speed of 3750 RPM, intermittent maximum 4500 RPM. Rotates to the right only. . . . . NEW 14.49

HP-3V-HAND PUMP

HP-3V-HAND PUMP – Operating pressure 2000 PSI. Capacity, 1.5 cu.in. per complete cycle. Has added feature of a diverter valve for selecting a suction & pressure port for two independent systems. . . . . ONLY 12.75

P-3 STRATO POWER PUMP With built-in variable flow control valve in head. Positive displacement piston type. Displaces .450 cu. in. per revolution. Two gal. per minute capacity at 1500 RPM at 1250 PSI. Pressure limit, 1250 PSI continuous. 1400 PSI for 15 seconds. Operates at 3750 RPM, intermittent max. 4500 RPM. Rotation either direction without adjustments. NEW 17.50

FOUR WAY VALVE

V-28 – Poppet Type. Off at neutral position. 3/8" AC Tube Ports – (9/16 - 20) thread. P.S.I. 1,500 . . . . . 4.75

V-17 – Poppet Type. Pressure balanced. Offset neutral position. Piston type with built-in relief valves for limit of cylinder strokes. ½" Standard pipe inlet & outlet ports. ½" AC tube to cylinder (¾" - 18) thread tapped ports. NEW 6.75

GEROTOR TYPE PUMP

Logan Gerotor type. For operating hyd. systems on tractors, trucks industrial machinery, etc. Delivers 8 GPM, at 1200 RPM, at 1000 PSI with 5 HP. Can also be used as Hydraulic Fluid Motor. Has 3/8" stnd, pipe ports, ½" splined shaft for pulley or direct attachment. 5½" dia. x 7" lg. Used but guaranteed condition. Now ONLY 17.50

We carry the World's Largest Supply of New Hydraulic Equipment featuring over 20,000 Cylinders in 61 Sizes & Types. Can also supply all accessories such as Pumps, Fittings, Valves, Tanks, Hose Fittings. Let us solve your Hydraulic problems. Write for inform.

WRITE TODAY for 1950 TOOL CATALOG. 72 PAGES of BARGAINS in Machine Tools (lathes, drills, saws, reamers, etc.) Hydraulic Cylinders, Valves, Pumps & Motors. Air Tools & Bearings.

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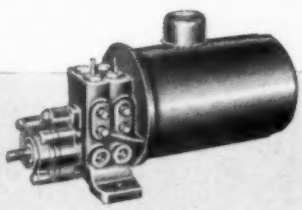
## Another Job for Pesco HYDRAULIC MUSCLES



Pesco Hydraulic Power package model 05-2252-010. Pump displacement .433 cu. in. Capacity 2.75 g. p. m. @ 1600 r. p. m. @ 1200 p. s. i. Package includes relief valves, check valves, and reservoir.

# PESCO POWER PACKAGE operates BOTH Hydraulic Header Lift and Variable Speed Drive on Deluxe COCKSHUTT Combine

Offering a new range in performance, never before equalled in combine design, the new Deluxe Cockshutt "Drive-o-matic" combine makes possible great savings in threshing time and a much greater yield in grain threshed.

By designing the combine so that a single unit Pesco hydraulic Power Package provides the necessary power for both lowering and raising the combine header, to compensate for variations in crop heights and ground levels, and for regulating the forward speed of the combine itself, Cockshutt engineers have made it possible for the operator to meet all harvesting conditions with finger tip control.

The preciseness, ease, and accuracy with which Pesco hydraulic muscles can handle such complicated, heavy, and sometimes awkward operations, is only one important reason why more and more farm and industrial equipment manufacturers are turning to Pesco for answers to their hydraulic power problems.

Perhaps this sales power of Pesco hydraulic power can help you, too. For the complete story, write today.

engineering Pesco production

**PRODUCTS DIVISION**

**BORG-WARNER CORPORATION**

24700 NORTH MILES ROAD BEDFORD, OHIO

Circle 2 on Reader Service Card

# "The bonds we bought for our country's defense are helping our boy become a doctor!"

**HOW U. S. SAVINGS BONDS ARE PAYING OFF FOR JOHN AND HELEN DALY OF STOCKTON, CALIFORNIA**

*John and Helen Daly are proud of their son, James. "Jim always wanted to be a doctor," says Helen, "and now he's getting his chance to study medicine, thanks to our U. S. Savings Bonds and the wonderful Payroll Savings Plan!"*

**"Jimmy was only 13** when John and I decided to make U. S. Savings Bonds a part of our plan for his future. I signed up then for the Payroll Savings Plan in the Stockton Naval Supply Annex where I work."

**"We've saved $3,550, now.** John has his phonograph business so I'm able to put more than 25% of my salary into Payroll Savings. I buy a $100 bond each month which goes toward paying for Jim's education."

**"Jim's at the University of Santa Clara** now, taking pre-medical work. Bonds are paying his tuition, and we're still buying them toward that M.D. for him. The Savings Bond method is wonderful for parents!"

## The Dalys' story can be your story, too!

Whatever your dream, you can make it come true just as the Dalys did. But you've got to start *right now!* That's easier than you think if you take these simple steps:

1. Make the big decision—to put saving *first* before you even draw your pay.

2. Decide to save a regular amount systematically, week after week or month after month. Even small sums saved on a systematic basis become a large sum in an amazingly short time!

3. Start saving automatically by signing up *today* in the Payroll Savings Plan where you work or the Bond-A-Month Plan where you bank. You may save as little as $1.25 a week or as much as $375 a month. If you can set aside just $7.50 weekly, in 10 years you'll have bonds and interest worth $4,329.02 cash!

You'll be providing security not only for yourself and your family but for the blessed free way of life that's so important to us all. And in far less time than you think, you'll discover that you have turned your dreams into reality, just as the Daly family did.

**FOR YOUR SECURITY, AND YOUR COUNTRY'S TOO,**
**SAVE NOW—THROUGH REGULAR PURCHASE OF U. S. SAVINGS BONDS!**

## APPLIED HYDRAULICS

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